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AN INTERIM GUIDE TO INDUSTRIALIZED BUILDING SYSTEMS.(U)
JAN 76 S T LANFORD, T D CSIZMADIA, D BRYANT

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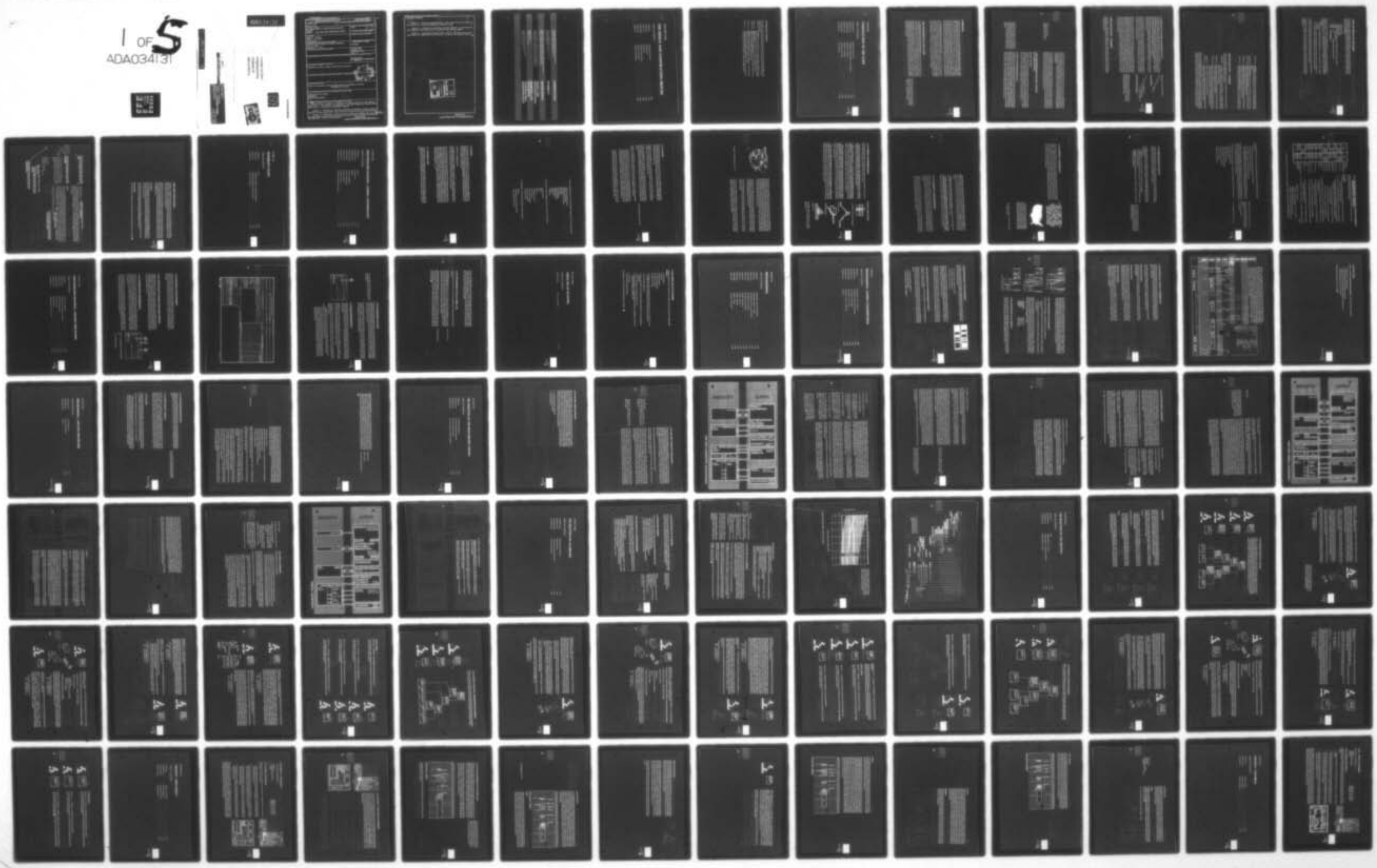

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Each chapter in Volume I is devoted to a primary activity in the procurement process. The chapters are organized in the same sequence as the activities which occur in the building procurement process:

Chapter 1: Feasibility, provides guidelines on whether a project should be executed through conventional means or by using industrialized building methods;

Chapter 2: Programming, describes how to define and schedule the work; OVER

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Chapter 3: Design and Documentation, directs specification writing and the defining of interfaces between building and site;

Chapter 4: Proposal and Evaluation, provides methods for selecting the best response from industry and for awarding the contract; AND

Chapter 5: Construction Administration, defines the construction documents which are required of the contractor, as well as the quality control.

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VOLUME ONE

THE DESIGN AND CONSTRUCTION PROCESS

TABLE OF CONTENTS

VOLUME ONE: SUMMARY

Each chapter in Volume One is devoted to a primary activity in the procurement process. The chapters are organized in the same sequence as the activities which occur in the building procurement process:

Chapter One, **FEASIBILITY,** provides guidelines on whether a project should be executed through conventional means or by using industrialized building methods

Chapter Two, **PROGRAMMING,** describes how to define and schedule the work.

Chapter Three, **DESIGN AND DOCUMENTATION,** directs specification writing and the defining of interfaces between building and site.

Chapter Four, **PROPOSAL AND EVALUATION,** provides methods for selecting the best response from industry and for awarding the contract.

Chapter Five, **CONSTRUCTION ADMINISTRATION,** defines the construction documents which are required of the contractor, as well as the quality control.

INTRODUCTION TO THE GUIDE

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FOREWORD

The Systems Building Branch of the **Construction Engineering Research Laboratory (CERL)** prepared this guide for the Directorate of Military Construction, Office of the Chief of Engineers (OCE). Principal Investigators were Samuel T. Lanford, Tibor D. Csizmadia and Dale Bryant. Other CERL personnel working under Dr. Robert M. Dinnat were Dr. D. Gordon Bagby, Ms. Marina A. Britsky, Mr. John C. Hamilton, Mr. Michael Carroll, and Mr. George A. Trosky. A primary input was made by the Engineers Collaborative, Ltd. (Chicago); the other contributors were Professors Eric C. Freund, Clyde W. Forrest, Jr., and Christopher A. Moyer (University of Illinois); the Small Homes Council/Building Research Council, the Survey Research Laboratory (University of Illinois); and the office of *Industrialization Forum*, who assisted in editing. The technical monitor was Mr. William E. Johnson (Engineering Division, Structures Branch).

This **INDUSTRIALIZED BUILDING SYSTEMS GUIDE** is designed as a workbook for District Engineers and other military decision-makers who need assistance in the procurement of buildings, particularly buildings which utilize industrialized building methods. The guide does not supersede regulations, directives, standards or specifications, nor is it intended to abridge command authority or responsibility. It will be implemented by a separate directive. CERL may issue periodic changes whenever new materials and important technological or organizational developments are introduced or if existing design criteria are changed.

1:001 BACKGROUND TO THE GUIDE

This **INDUSTRIALIZED BUILDING SYSTEMS GUIDE** was written by the *Master Planning and Systems Building Branch* of the Construction Engineering Research Laboratory (CERL) to promote the effective application of innovative building technology and management methods in Army construction. Several years were spent investigating the state of the art of industrialized building, surveying the suitability of products and services, and compiling a list of producers of factory built buildings.[1] Based on the recommendations of this study, a project was undertaken to construct a 300-man Bachelor Officers' Quarters at Fort Knox, Kentucky, using industrialized building systems. One result of that project was the decision to begin the preparation of this guide.

[1]*BAGBY, D.G., R.M. Dinnat, and C.A. Moyer, Study on the Potential Use of Industrialized Building for the Department of the Army, CERL, Vol. 1, August 1971, Illinois.*

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The guide is a product of on-going research for the purpose of providing a comprehensive and practical handbook for District Engineer offices. It is in the continual process of being improved. Its content will be constantly tested, updated, modified and revised. The guide, therefore, is an imperfect but potentially valuable tool for users needing information on industrialized building methods, the systems approach to building procurement, and their application to military projects.

Since it is intended for the district engineer, the guide's effectiveness depends on the reader's or user's knowledge, skill and thoroughness. Its future effectiveness depends on the feedback to be received from those who have used the guide. CERL requests your remarks, suggestions and experiences regarding industrialized building and this guide. To encourage your participation, blank pages are provided at the end of each volume for comments; send them to the *Chief of the Master Planning and Systems Building Branch* at CERL.

1:002 INDUSTRIALIZED BUILDING SYSTEMS: AN INTRODUCTION

Objectives of the Guide

The official policy of the *Corps of Engineers* is to make maximum use of innovative procedures wherever it can be shown that tangible benefits are gained. Case studies have shown that by careful application of authorized procurement methods to industrialized techniques and products, it is possible to construct buildings of better quality, at lower overall cost, in a shorter period of time. The objective of this guide book is to explain these procedures.

The Methods of Industrialized Building Systems

A BUILDING SYSTEM IS AN ARRANGEMENT WHICH PERMITS MANY DETAILED DECISIONS CONCERNING A METHOD OF CONSTRUCTION TO BE MADE FOR A RANGE OF BUILDING SITUATIONS IN ADVANCE OF ANY PARTICULAR BUILDING PROJECT.

This report includes no attempt to precisely define the meaning of industrialized building but will use the term as an umbrella under which can shelter a number of different innovative approaches to constructing buildings. One general feature of these different methods of industrialized building is an increase of the use of components (or even complete buildings) manufactured off-site—under factory conditions—and a corresponding decrease in the use of site-formed materials. The increased use of the prefabricated principle results in necessary changes in the sequence of decision-making in the design and construction process.

A Comparison Between Conventional and IBS Building Procurement

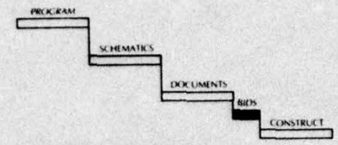
Conventionally, buildings are bought (and therefore built) on an individual basis. After the client selects his architect, they program the client's needs. The architect must prepare a design which responds to this program, and then communicate what is required from industry. The contractor who submits the lowest price gets the job, and subsequent actions are sequential, with each step having to await the completion of its predecessor.

With industrialized building methods and extensive prefabrication of parts, the decision-making process can no longer be linear. *And the architect can no longer dictate the detailed design of the building.*

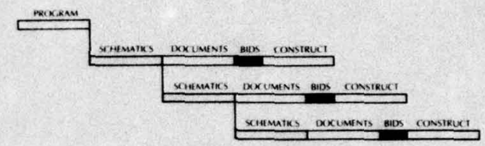
Many of the decisions a producer makes concerning fabrication methods have no regard to specific building projects. Therefore, the selection of a producer will affect the final design of the building, and design cannot be completed until the producer is selected. This change in the sequence of decision-making is one of the prime distinctions between industrialized building systems and traditional building.

Because of this change in the decision-making sequence, many conventional building procurement procedures that the client uses must be modified or discarded. The client, rather than prescribing precisely what he wants, has to select the building which best meets his basic requirements. Some types of building systems are very *flexible* and *allow a wide range of design alternatives*, while other types offer only very limited options. Highly flexible systems are often referred to as "open" systems, while systems which limit design flexibility are called "closed" systems. The intent of this guide is to explain specific procedures which relate to specific types of buildings and which are applicable in specific circumstances. The information presented is based on *experience*, not theory. Further experience will permit extension of the scope of the guide.

The Sequences of Decision-Making



CONVENTIONAL



INDUSTRIALIZED BUILDING

DEPENDING ON THE DESIGN CON/
TROL REQUIRED BY THE CLIENT, THE METHOD OR PROCESS OF BUYING THE BUILDING WILL VARY

1:003 VOLUME ONE: SUMMARY

Each chapter in Volume One is devoted to a primary activity in the procurement process. The chapters are organized in the same sequence as the activities which occur in the building procurement process:

Chapter One,	**FEASIBILITY,** provides guidelines on whether a project should be executed through conventional means or by using industrialized building methods
Chapter Two,	**PROGRAMMING,** describes how to define and schedule the work.
Chapter Three,	**DESIGN AND DOCUMENTATION,** directs specification writing and the defining of interfaces between building and site.
Chapter Four,	**PROPOSAL AND EVALUATION,** provides methods for selecting the best response from industry and for awarding the contract.
Chapter Five,	**CONSTRUCTION ADMINISTRATION,** defines the construction documents which are required of the contractor, as well as the quality control.

1:004 VOLUME TWO: SUMMARY

Volume Two contains supplementary information to the directives of *Volume One*; these data may be referenced throughout project execution.

Chapter One	is a study of significant innovative building procurement programs which provide conclusions as to the size and type of project which will justify the use of IBS methods.
Chapter Two	tabulates certain aspects of the MCA Program procedures which may assist District Engineers responsible for IBS projects.
Chapter Three	contains recommended performance levels which should be used in specifications for each type of industrialized building project. There is also a sample performance specification for a typical building subsystem.
Chapter Four	outlines information sources for IBS procurement.
Chapter Five	contains a glossary of terms, a list of acronyms and abbreviations, and an explanation of the formulae used in the Feasibility Study.

There is a two-part bibliography on IBS *procurement methods,* and on *user needs and building design.* Access to computerized information on products from a data bank maintained by CERL is explained; a list of other data banks and building research is included. In addition, there are addresses of agencies involved directly or indirectly in the development of IBS methods.

1:005 THE FORMAT OF THE GUIDE

Each of the two volumes is divided into chapters; each chapter is subdivided into sections and sub-sections. Because CERL intends to continually update the report, the pages are not consecutively numbered. Preceding each heading is a unique reference number, whose format is explained below:

```
Volume number
| Chapter number
| |Section number
| ||Sub-Section number (not included in page titles and numbers)
| |||      Title of section
| |||      |            Page number within the section
| |||      |            |
1:234      Fixed Design 01
```

Each section can be removed and additional sections and chapters added independently of the other sections; there is capacity within the numbering system for additional chapters, sections and sub-sections. The beginning of each volume, chapter and section contains a table of contents:

(a) The table of contents at the beginning of each volume lists the main chapter headings;

(b) The table of contents at the beginning of each chapter lists the section headings; and

(c) The table of contents at the beginning of each section lists the sub-sections.

As additional chapters, sections and sub-sections are issued, the appropriate page(s) should be removed and replaced. Revised tables of contents will also be issued.

The layout of each page is similar. The outside margins contain additional information such as supplementary graphics, cross references, footnotes, key words and instructions (see typical page layout).

The side column provides space for the users' own reminders and "how-to-do-it" tabs.

Construction Time

Headings will normally label steps in their order of accomplishment.

Actual construction time can be expected to be reduced, since the successful contractor will be constructing the project with a familiar set of parts which reduce much of the handcrafting necessary for conventional construction. In addition, much of the fabrication will take place under factory controlled conditions, and can be field-erected as larger components of the total building.

Footnotes often direct the user to an option to research an operation or subject more thoroughly.

Budget

Revise your first cost estimate to provide a figure for budget review: add the probable cost of site work to the building cost estimate obtained in your FEASIBILITY study. Figure site work at 7.5% of building cost[1] unless you know overriding site conditions will require significant deviation from this figure—either upward or downward. Accompany this revised cost estimate with your preliminary site plan, which should be annotated, "To be adapted as required to accommodate proposer's system."

Each principal topic is concluded with CERL's symbol (a turret).

Turn now to Check List and End Tasks, Section 1:290.

The whole GUIDE is programmed to permit users to skip those topics which do not apply to their particular projects.

[1]A site cost of 7.5% of the building costs is an average based on 93 systems projects reported by Building Systems Information Clearinghouse, along with 43 conventional projects reported in *Engineering News Record*.

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The Section number and title are noted above the tab.

The black tab shows the chapter on every sheet, and aligns with those in the table of contents.

The large page numbers permit inserts and replacements, since they start over with each sub-section.

1:006 USER INSTRUCTIONS

This guide is not designed to be read from cover to cover. The beginning of each chapter in Volume One contains an introductory section which describes in general terms what that major activity involves, stressing the differences resulting from the replacement of conventional methods by the systems approach.

Depending on the particular requirements of a project, some tasks are optional, and some apply only to specific procurement types or strategies. By means of a system of cross references, the reader is guided through the relevant sections of Volume One. Volume Two entries are independent of one another and are to be used as referenced from Volume One or as they are needed by users.

Terminology

The three building types chosen as most amenable to procurement through IBS are *bachelor housing, administrative and classroom facilities,* and *warehousing,* often abbreviated for convenience in the GUIDE to read HOUSING, ADM/CLR and STORAGE. For other abbreviations and acronyms, see 2:521.

Some terms need clarification. Meanings have changed for some familiar words in the evolution of IBS and new expressions have emerged. For definitions, see 2.511.

IBS Information

Those who wish to explore books or journal articles should utilize Sections 2:410-2:440. ■

chapter one

FEASIBILITY STUDY

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SECTION ONE

INDUSTRIALIZED BUILDING: GENERAL CONSIDERATION

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1:110 SCOPE

This first chapter (THE FEASIBILITY STUDY) is divided into three sections: **Section One** presents factors which affect the decision to recommend the use of IBS for a particular project. **Section Two** specifies the steps necessary to make a recommendation for the use of IBS within existing procedures and regulations. **Section Three** can be used to organize the activities necessary to complete a feasibility study.

FEASIBILITY CONSIDERATIONS:

Considerations affecting the feasibility of using IBS for a particular construction project or, alternatively, the feasibility of adapting the project or construction program include *building type, long term planning, design constraints* and *production capacity.*

The use of IBS should be seriously considered for every building project undertaken in the military construction program. The following discussions will point out project characteristics which will aid in screening out projects which are not amenable to industrialized construction, as well as suggesting conditions which call for specialized treatment. Consideration of the use of IBS is appropriate when DD 1391's are first received. A reliable procedure for determining whether to consider the use of IBS follows; it is possible to complete this feasibility study for a new project in fifteen minutes. A one page summary form is provided for recording the results of these studies (Subsection 1:117).

1:111 BUILDING TYPE

Generally speaking, any building can be built using IBS. However, unless there is large enough a project to justify the cost of development of an entirely new system, consideration of the use of IBS should be limited to building types for which a wide selection of products exist off-the-shelf.

02

A variety of building types are currently available; following are the most common types:

- Single family detached houses
- Duplexes and Triplexes
- Row Houses (Town Houses)
- Apartments
- Dormitories
- School Buildings
- Portable Classrooms
- Office Buildings
- Warehouses
- Garages
- Gymnasiums

Translated into military language we have, with minimum modification:

- Family Housing
- BOQs
- BEQs
- Barracks
- Dependants' Schools
- Service Schools
- Headquarters Buildings
- Operations Buildings
- Storage Facilities

This guide deals with these types grouped into three categories:

- Housing
- Administrative and classroom facilities
- Warehousing/storage facilities

1:112 PLANNING

Industrialized building gains much of its efficiency due to repeated operations. Generally, mass production results in reduced unit cost. This "economy of scale" advantage suggests that in order for a project to benefit from the application of industrialization, it must be large. This is not, however, necessarily true.

Depending on the building type, it is possible to benefit by buying off-the-shelf buildings or products for small projects. The producers' requirement for a large market may be satisfied by a wide range of customers other than the army.

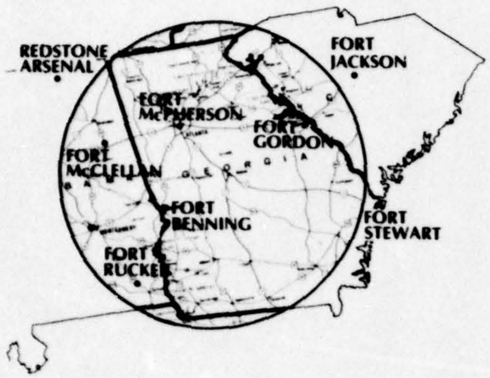
If, however, a large *project is contemplated*, or a number of small projects all require similar or identical buildings, the use of IBS offers a unique opportunity for the government to benefit from economy of scale. Aggregation of projects over distance or time is well worth investigating even though present administrative procedures tend to favor constructing buildings one at a time.[1]

There are no firm guidelines on the optimum size of the construction package or program. However, on the basis of past experience, the following suggestions can be made:

- *A multi-million dollar volume is not necessary for projects utilizing existing systems or components*. In fact, if a project is too large it may exceed the production capacities of most manufacturers. Do not eliminate a project from consideration unless it is either unusually large or extremely small. In the case where the project will require new products to be designed and developed, however, a large enough production run must be contemplated before a manufacturer will be willing to tool up to produce it.

- *Continuity of demand over two or more years is preferable to a "one shot" project*. This is particularly true when new products are being developed for a project, since the manufacturer will desire a continuing market to justify his original capital outlay.

[1]See *Case Histories*, Section 2:100



- *With aggregation, a geographically-concentrated project is better than a geographically-dispersed project.* When buildings are being produced in factories, some of the savings accruing from the efficiency of mass production are being spent on transportation of the finished product to the site. Beyond a certain distance it becomes more expensive to ship the buildings than was saved by factory fabrication. For three dimensional modules of concrete or steel this distance by road is typically 250 miles. For wood modules or panels the distance increases to 350-400 miles or more. For open system components, the distance may be from 500 miles to nationwide.

- *Some parts of the United States do not have an adequate number of producers of some IBS building types.* This is particularly true in the North Central region. The lack of nearby manufacturers may tend to limit the advantage of IBS, especially if there is adequate conventional building capacity in this area.[1]

- *Industrialized building may be of extreme advantage in very remote areas or in areas with acute labor shortages.* For example, industrialized building has been very successfully utilized in Alaska.

- *Early occupancy of off-the-shelf buildings is a distinct possibility as construction time can be significantly reduced in comparison to conventional construction.* Projects where facilities are needed ahead of what could normally be provided by conventional methods can almost certainly benefit from use of IBS.

[1]Check the CERL/TIBS data bank (2:431)

1:113 DESIGN CONSIDERATIONS

Although the best IB systems offer some design variation, they are designed for typical situations. The following design considerations should be examined:

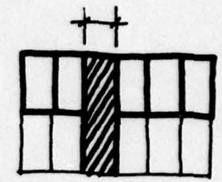
– **If the site is so restrictive and irregular as to limit building dimensions that it would dictate unusual floor plans, multiple floor levels or other departures from the norm.** The necessary changes could more than offset potential savings offered through IBS.

– **If there is a significant portion (*i.e.*, over 25%) of the construction budget allocated to non-building items (*i.e.*, site work, roads, and utilities), conventional processes may be advisable.** Such a limitation assumes that the systems builder would be asked to contract for the entire project. If so, he may not be equipped to perform extensive non-building functions. If these items can be awarded on a separate contract, however, this is not a limitation.

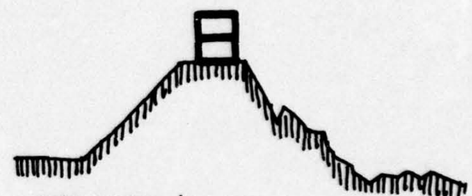
– **Consider whether the building program requires unusually high performance relative to structural loading, earthquake resistance, wind loading, acoustic performance or temperaature control.** IBS products usually conform to most building codes, but they are seldom over-designed to respond to extreme requirements without modification. On a large-scale program, however, the performance approach may be even more advantageous than conventional to answer to special criteria.[1]

– **There can be problems if the building must match existing buildings of a particular architectural style.** The appearance of IBS can be specified and regulated to assure esthetically pleasing buildings, but a specification requiring a precise matching of materials or details will probably require departure from off-the-shelf products and either increase cost or decrease industry response (and therefore competition)—probably both.

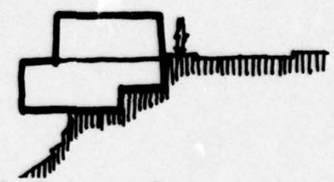
Examples of Design Limitations



...lot width too narrow for building type



...extreme terrain



...difficult topography

...irregular site

[1]See CERL report, *Functional Life As A Basis For Design* (John Hamilton and Gordon Bagley, PIs)

– **The program may call for rooms which are unusually large, irregular or unique to the military.** Examples of difficult spaces are large auditoriums, certain testing laboratories, or vaults. It is generally the practice—with "open systems" school buildings—to award one contract for the *systems* portion of the work (e.g., the classrooms and administrative areas), and a separate contract for the *non-systems* portions (the gymnasium, kitchen or communication center).

– **Modifications to systems components are expensive.** To gain maximum advantage of the use of IBS, use them in accordance with the manufacturer's intent.

– ***It is likely,* especially in ADM/CLR Buildings, that the functions housed are likely to change over time which would require partitions to be moved.** This remodeling requirement suggests the use of the "open systems" approach and is an excellent reason for the use of IBS, since performance requirements for *flexibility* are easily met by most subsystems suppliers.

1:114 CONTRACT ADMINISTRATION

One advantage of using IBS is the potential for reduction of construction time, permitting earlier occupancy. Since the progress of construction is accelerated, the time allotted for Army decisions must also be accelerated and *carefully programmed*. During planning, as well as in consecutive stages, certain key decisions must be made earlier than for conventional construction.

Therefore, it is important for construction agency personnel to appreciate the nature of this approach. Personnel with specific experience in the IBS approach are needed, either in-house or from outside, and should be assigned to the project at the outset. The choice of A/E should also take into consideration their experience using IBS.

1:115 EXTERNAL CONSTRAINTS

The introduction of IBS has been actively opposed by vested interests within the building industry. Opposition has been either direct (by outright refusal to cooperate—*e.g.*, work stoppages), or indirect (by restrictive building codes, which unnecessarily dictate choice of materials and methods).[1] *Every effort should be made to overcome* these restraints. Experience has shown that, by early consultation with the appropriate parties, many of the restraints can be removed by mutual agreement. However, if the opposition is entrenched, it may be necessary to revert to conventional methods.

ALASKA ■ ALABAMA ■ ARIZONA
CALIFORNIA ■ COLORADO ■ CONNECTICUT
FLORIDA ■ GEORGIA ■ HAWAII
IDAHO ■ INDIANA ■ IOWA ■ MAINE
MARYLAND ■ MASSACHUSETTS
MICHIGAN ■ MINNESOTA ■ MONTANA
NEW MEXICO ■ NEVADA ■ NEW YORK
NORTH CAROLINA ■ OHIO ■ OREGON
PENNSYLVANIA ■ RHODE ISLAND
SOUTH CAROLINA ■ VIRGINIA
WASHINGTON ■ WEST VIRGINIA

By summer of 1974, thirty states had enacted enabling legislation permitting the use of factory-built housing in any community in the State, overcoming the traditional constraint of diverse and restrictive building codes and regulations. Louisiana also had such legislation in process. (National Bureau of Standards Technical Note 853)

[1]*The editors recognize that local codes will not normally apply.*

1:116 PRODUCTION CAPACITY

For very large-scale programs, it is possible to persuade industrial concerns to develop a new building system for a particular specialized project. However, for the majority of building projects, it is necessary to use systems already in existence.

To determine whether there is adequate potential (e.g., number of producers in operation within shipping distance) to assure sufficient competition for the different building types, check these guidelines:

A **housing** project requires the prospect of a minimum of *six* proposers;

An **adm/clr** project should have the prospect of a minimum of three proposers with *E.F.L.*[1] *or similar experience;*

A **storage** project has no restriction (producers are readily available in all areas of the conterminous United States).

[1]E.F.L. schools are those built with subsystems components developed for the systems programs sponsored by the Educational Facilities Laboratories (see the University of Illinois BPSG data bank)

General information on the availability of potential proposers can be obtained from the following sources:

The National Association of Building Manufacturers (NABM);

The Associated General Contractors (AGC);

The National Association of Home Builders (NAHB)[1];

The classified telephone directory listing (yellow pages) under headings such as *Prefabricated Buildings, Modular Buildings, Package Buildings* and *Industrialized Buildings.*

CERL/TIBS (Technical Information on Building Systems) is one of the largest collections of information on industrialized building. Specific information can be obtained from this data bank.[2] The request for information should include a brief description of the product and/or services required, plus the location of the project.

Examples of information available on manufacturers[3] (depending on their data released) are:

- Competitive shipping radius
- Completed projects
- Federal agency experience
- Form of product when delivered
- Limiting clear plan of structure
- Fire resistance rating
- Electrical code compliance

[1] *Addresses for these can be found in 2:44*

[2] *CERL-HM (Master Planning & Systems Building Branch), Box 4005, Champaign, IL 61820*
217-352-6511 (COMM)
217-352-6420

[3] *For a sample printout, see 2:431*

1:117 INDUSTRIALIZED BUILDING SYSTEMS FEASIBILITY DETERMINATION CHECKLIST

Using information derived from the DD 1391 and the PDB (TM 5-800-3) answer the following questions about the project.

YES Col. 1	YES Col. 2	NO Col. 3	NO Col. 4	Project information source reference	IBS GUIDE REFERENCE
				DD 1391 (7)	1.111 (01) Is the building type any of the following: Housing, administrative classroom, warehousing, athletic?
				DD 1391 (10)	1.112 (04) Is the estimated budget between $50,000 and $15,000,000?
				DD 1391 (10) other 1391's	(04) If the budget is greater than $10,000,000 then is there a potential for continued demand for similar buildings over several years?
				PDB site plan	(05) Is the project located either at a single location or several sites in a general locality?
				DD 1391 (9)	(05) Is the project to be built in an extremely remote area?
				DD 1391 (25)	(05) Is early occupancy an important consideration?
				PDB 5a (5)	1.113 (06) Will the site allow minor variation from the suggested site plan?
				PDB 7a	(06) Can the functions of the building be accommodated by a series of rectangular space?
				DD 1391 (19)	(06) Is the project a "building" project rather than a "site development" or "equipment procurement" project?
				PDB 7c(2)(a)2.	(07) Is there flexibility in external appearance of the building?
				PDB 7c(7),(12-16)	(07) Will a building meeting normal building code performance suffice?
				PDB 7c (15)	(07) Is there a requirement for flexible space. Future expansion or expected change of building function.
				CERL/TIBS data bank other sources	1.116 (09) Can three or more manufacturers supply buildings to this site?
					TOTALS

Interpretation of columns:

Column 1: Strong suggestion in favor of using IBS.
Column 2: Favors use of IBS.
Column 3: No effect on decision (irrelevant).
Column 4: May seriously adversely affect use of IBS.

*****MAKE COPIES OF THIS PAGE TO BE COMPLETED FOR EACH PROJECT THAT IS REVIEWED*****

SECTION TWO

INDUSTRIALIZED BUILDING: MILITARY PROCEDURES

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1:120 DECISION ACCOUNTABILITY

Since the courses of action open to the District Engineer are often limited by others in the procurement process, the effective introduction of IBS may require active encouragement from higher level military decision-makers. Given the District Engineer's operating limitations, it is necessary to describe the reasons for the decision to use IBS, as well as the implications of this action.

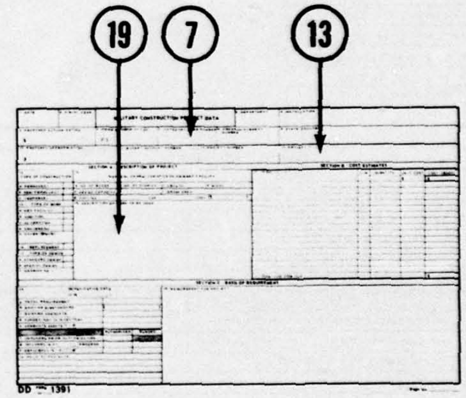
1:121 THE MILITARY CONSTRUCTION/ARMY PROCESS

Although modifications are needed in certain instances, the procurement procedures described in the *Guide* can be carried out within the framework of the Military Construction/Army (MCA) process. The modifications are covered in all instances by the Armed Services Procurement Regulation (ASPR) or other government directives. While the overall time frame is basically unchanged, minor modifications alter certain processes. Required schedule changes are discussed in Section 1:204.

1:122 INFORMATION REQUIREMENTS

The *D.D. Form 1391* and *Project Development Brochure (PDB)* submitted by the installation contain all the information needed to determine the feasibility of using IBS. The key items of information from *Form 1391* are building type (Items 7 and 13) and the description of work to be done (Item 19). The detailed information in the PDB can provide insight into the installation's perception of anticipated problems; use this information to shed light on those items discussed in 1:11.[1]

If a large group of 1391's are being reviewed simultaneously, investigate whether several similar projects might be combined under a single contract. Aggregation of projects may involve one or more installations or even two or more districts. Keep in mind, however, limitations imposed on delivery of IBS systems over long distances.[2]



[1]*See 1.117, evaluation form for IBS Feasibility*

[2]1:21 Military Procedures

02

MILITARY CONSTRUCTION PROJECT DATA

1. DATE	2. FISCAL YEAR	3. DEPARTMENT	4. INSTALLATION

5. PROPOSED AUTHORIZATION	6. PRIOR AUTHORIZATION	7. CATEGORY CODE NUMBER	8. PROGRAM ELEMENT NUMBER	9. STATE/COUNTRY
$	P.L.			

10. PROPOSED APPROPRIATION	11. BUDGET ACCOUNT NUMBER	12. PROJECT NUMBER	13. PROJECT TITLE
$			

SECTION A - DESCRIPTION OF PROJECT

14. TYPE OF CONSTRUCTION
a. PERMANENT
b. SEMI-PERMANENT
c. TEMPORARY

15. TYPE OF WORK
a. NEW FACILITY
b. ADDITION
c. ALTERATION
d. CONVERSION
e. OTHER (Specify)

16. REPLACEMENT

17. TYPE OF DESIGN
a. STANDARD DESIGN
b. SPECIAL DESIGN
c. DRAWING NO.

18. PHYSICAL CHARACTERISTICS OF PRIMARY FACILITY

a. NO. OF BLDGS	b. NO. OF STORIES	c. LENGTH	d. WIDTH
e. DESIGN CAPACITY		f. GROSS AREA	
g. COOLING	CAP	COST ($)	

19. DESCRIPTION OF WORK TO BE DONE

SECTION B - COST ESTIMATES

20. PRIMARY FACILITY	U/M	QUANTITY	UNIT COST	COST ($000)
			$	$
22. TOTAL LINE ITEM COST				$

SECTION C - BASIS OF REQUIREMENT

23. QUANTITATIVE DATA (U/M ______)

a. TOTAL REQUIREMENT		
b. EXISTING SUBSTANDARD	( )	
c. EXISTING ADEQUATE		
d. FUNDED, NOT IN INVENTORY		
e. ADEQUATE ASSETS (c + d)		
	AUTHORIZED	FUNDED
f. UNFUNDED PRIOR AUTHORIZATION		
g. INCLUDED IN FY ______ PROGRAM		
h. DEFICIENCY (a - e - f - g)		

24. RELATED PROJECTS

25. REQUIREMENT FOR PROJECT

DD FORM 1391
1 OCT 70

Page No. ______

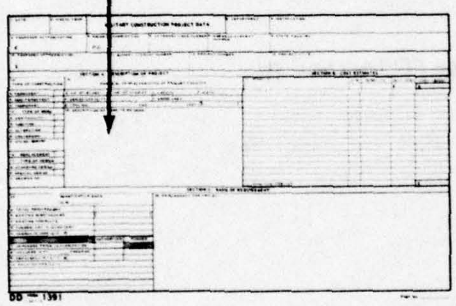
1:123 ESTIMATION OF COST

One purpose of the preceding *Feasibility Study* was to assure that costs for IBS on the proposed project would be competitive with conventional construction. With fluctuating prices of labor and materials, accurate estimates for even conventional construction is difficult.[3] Costs listed in Block 20 of DD 1391 are normally based on the square-foot value for a particular building type, as published in AR 415-17.

[3]*For an insight into the difficulty of accurate estimating of IBS costs, see Appendix 2:53 Formulae 02)*

Costs for IBS should be slightly lower than those for a conventional building, provided that the conditions set forth in 1:11 are met (e.g., that you plan to use off-the-shelf products without special modification). If modifications are required, costs will equal or exceed conventional costs, depending on the degree of modification.

19



1:124 RECOMMENDATION

If the preceding sections show that the project is suitable for IBS, a recommendation should be made to OCE that the project be constructed using IBS methods. The decision should be noted on *DD FORM 1391* under item 19, e.g., "Industrialized Building Systems will be considered for this project."

Specifications for IBS must be worded largely in terms of "performance". Different manufacturers must be free to propose alternative materials to satisfy each requirement. Therefore, care must be taken in describing the project even at this early stage.

The wording of Item 19 should not be unnecessarily specific, as this can cause difficulties in developing an economical and satisfactory design. For example, if a description of work is written as follows:

> "Unit masonry walls and partitions, steel roof framing, rigid slab roof insulation and built-up composition roofing; hot water heat from gas fired boiler and evaporative cooling",

it should be rewritten in more functional terms, such as:

> *"Provide a permanent noncombustible building including foundations, structure, exterior enclosure, interior space division and finishes, HVAC, electrical, plumbing, lighting, and communication. Include functional spaces for offices, classrooms, briefing rooms, a communications area, vault and necessary auxilliary support spaces. Provide complete storm drainage, parking spaces for 100 vehicles, sitework and utilities. Use natural gas for heating and domestic hot water."*

Section 7 of the PDB should be checked for highly prescriptive specifications; these should be re-written for an IBS project section 7 (Architectural and Structural), using performance specifications. Check especially subsections 7c(1)—7c(5), where exact dimensions or specific materials may have been cited. Substitute ranges of acceptable dimensions or materials properties, or else reference a performance standard.

1:125 ATTACHMENTS TO D.D. FORM 1391

In order to avoid unnecessary delays later on, the following two attachments may be included at this time.

A/E Selection Approval: If the project is very large (or if you have aggregated many smaller projects), the A/E fee required may be in excess of $100,000. Where an A/E award is estimated to exceed $100,000, there must be special selection approval by the next higher level of the construction activity (ASPR 18-4023). Also, if the A/E contract actually exceeds $100,000, a *quarterly report* must be furnished to the ASD (I&L) per ASPR 18-404.2.

See Section 1:230

Environmental Impact Statement: Any challenge because of legislation or public sentiment about conservation could cause indefinite delay. In such a case, attach the required *impact statement* to your 1391. Check 1:296 for information covering the wording of the statement for an IBS project. Since the environmental impact can be reduced with IBS, this could be one decisive factor. ■

See PDB Section 4d

SECTION THREE

CHECK LIST OF ACTIVITIES

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1:130 CHECK LIST OF ACTIVITIES

Establish in general terms the validity of using industrialized building methods. **Check when completed:**

- ☐ building types;
- ☐ planning
- ☐ design limitations;
- ☐ contract administration;
- ☐ external constraints;
- ☐ production capacity.

- ☐ Complete two copies of the IBS Feasibility checklist (see 1:117). Carry out a more detailed examination which takes into account existing military procedures.

- ☐ MCA Program Implications.

- ☐ Review DD FORM 1391 and the PDB and make modifications if necessary before re-submitting.
- ☐ Check construction costs estimate with AR 415-17.
- ☐ Submit DD FORM 1391 and attachments and make recommendation on the use of industrialized building methods to OCE.

- ☐ A/E Services
- ☐ Environmental Impact Statement.

Upon approval, proceed to the Programming Phase, Chapter 2.

chapter two

PROGRAMMING

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PROGRAMMING: GENERAL CONSIDERATIONS

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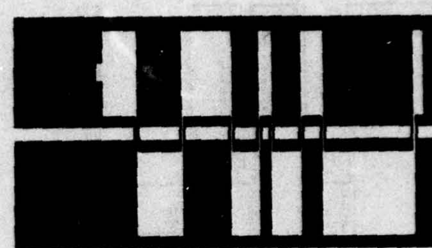


1:200 PROGRAMMING: THE KEY DECISIONS

Assuming that it has been deemed feasible to adopt IBS methods for the building project, this second chapter describes how to define and schedule the program of work. In *programming*, the key decisions are first made:

- the selection of the procurement option;
- the selection of the strategy; and
- the selection of the A/E services.

These interrelated decisions affect both the scheduling and programming of design and construction. The alterations to conventional programming, resulting from the introduction of IBS methods, are detailed in later sections. Special programming considerations resulting from military regulations are described in Section One.

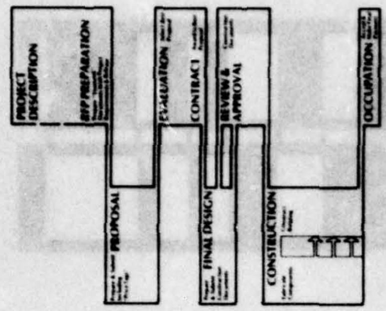
In *programming*, the sequence of decision-making is complex. Decisions on the approximate schedule for all procedures should be made early. Further information and detailed studies can help to refine these decisions. Below are some factors affecting preliminary programming.

1:201 THE SELECTION OF THE PROCUREMENT OPTION

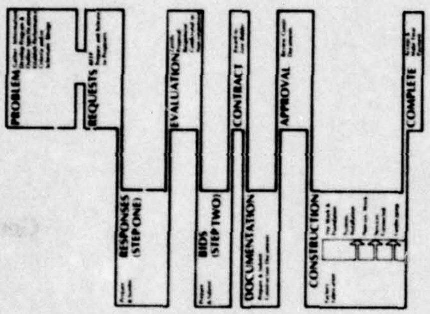
Traditionally, because the design was fixed, the contractor who submitted the lowest bid was selected to construct the building.

With IBS, the selection of a fabricator/builder becomes more complicated because the different designs which are submitted from industry have to be evaluated in addition to examining bids; cost is no longer the single criterion for selection. *Section Two* reviews three procurement options:

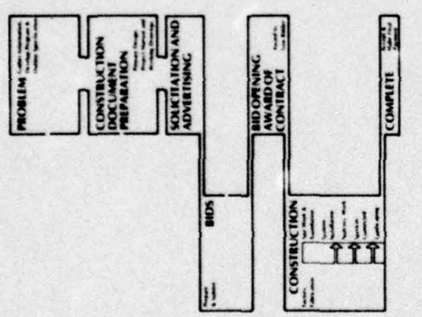
- one step competitive negotiations;
- two step formal advertising;
- formal advertising (competitive bidding).



ONE STEP COMPETITIVE NEGOTIATIONS



TWO-STEP FORMAL ADVERTISING



FORMAL ADVERTISING (COMPETITIVE BIDDING)

The procurement option is more than just a contract type; it includes that as a part of a comprehensive process, consisting of how the owner issues a "call-to-industry", industry's response, and the way the contractor is selected. The choice of a particular procurement option also relates to the choice of a procurement strategy. In general, the greater the flexibility of the design requirements and the fewer the design restraints imposed by the design strategy, the more complex the evaluation process may become. See 1:220 for details.

1:202 THE SELECTION OF THE STRATEGY

The selection of the strategy is dictated by two main considerations:

1. For an owner to get what he wants, he must be able to control in detail what gets built. However,
2. there is greater potential for competition between different systems if design restraints are minimized.

Clearly these two demands conflict and some form of compromise is needed. The optimum solution varies, depending on such factors as the type of building required, the availability of building systems, and the detailed program requirements. The details of matching an appropriate strategy with the particular set of circumstances being considered are given in 1:240-1:243. Four main alternative strategies are given:

- **Fixed Design** — Section Five
- **Footprint** — Section Six
- **Sequential** — Section Seven
- **Package** — Section Eight

1:203 THE SELECTION OF A/E SERVICES

The scope of A/E services for IBS differs significantly from traditional services. The tasks that should be required of an A/E consultant depends on both procurement option and the strategy which have been selected. His unique tasks are detailed in 1:231-1:234.

1:204 SCHEDULING: GENERAL CONSIDERATIONS

IBS methods require modifications to the standard Military Construction Army (MCA) process. The necessary modifications vary depending on which strategy is selected, which procurement option is selected and which services are required from the A/E. Detailed modifications are given in 1:250-1:280.

The more common modifications to the MCA cycle with each of the three procurement options follow as guidelines for scheduling the time needed for the different tasks.

Design and Documentation

Approximately two-thirds the time required for a conventional project should be allowed for document preparation. For a relatively simple project, it may be possible to further reduce the time required.

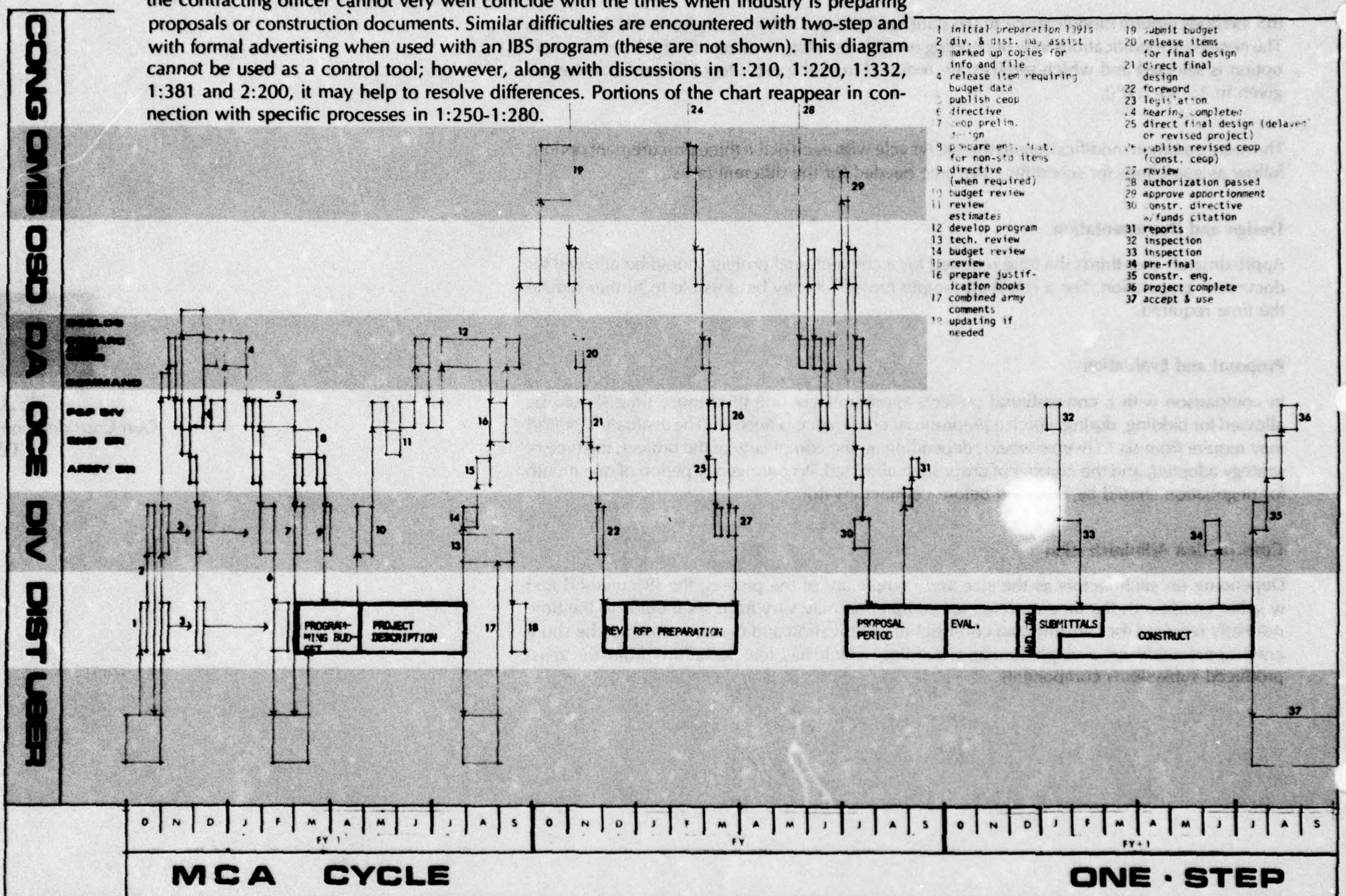
Proposal and Evaluation

In comparison with a conventional project, approximately one third *more* time should be allowed for bidding, during which a preproposal conference is needed. The *evaluation period may require from six to twelve weeks*, depending on the complexity of the project, the type of strategy adopted, and the number of proposals submitted. A contingency period *of one month for negotiation* should be provided before contract award.

Construction Administration

Depending on such factors as the size and complexity of the project, the IBS method and weather conditions, the time required for completion may vary from six months to the time normally required for conventional construction. Facrication and Construction may be shortened appreciably on a single-function building which has few variations from the mass produced subsystems components.

This chart — an attempt to superimpose one-step procurement onto the familiar process developed for formal advertising — shows graphically some of the constrictions encountered because of the periods awaiting project approval and funding. These "holding" periods for the contracting officer cannot very well coincide with the times when industry is preparing proposals or construction documents. Similar difficulties are encountered with two-step and with formal advertising when used with an IBS program (these are not shown). This diagram cannot be used as a control tool; however, along with discussions in 1:210, 1:220, 1:332, 1:381 and 2:200, it may help to resolve differences. Portions of the chart reappear in connection with specific processes in 1:250-1:280.



1:205 END TASKS

Before proceeding to **Design and Documentation,** a series of end tasks are required:

- development of a design program;
- retrieval of design data and building systems data;
- submission of an Environmental Impact Statement (if required), and
- sending out preliminary notices to industry.

These activities are detailed under 1:290.

SECTION ONE

PROGRAMMING: MILITARY PROCEDURES

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1:211 MCA PROGRAM IMPLICATIONS

In Section 2:210, entitled *MCA Program Procedures*, are notes on the implications of the army regulations AR415-15 and 415-20 on the adoption of industrialized building methods. These notes should be reviewed and the necessary actions taken at the beginning of the programming.[1]

[1] FY 1975 MCA Program Guidance, Change Four to AR 415-35; see also 2:212 and 2:213

1:212 EARLIER PROJECT APPROVAL

The times required in the schedule for project approval by higher authorities are waiting periods and are not significantly changed by the introduction of IBS methods. In certain instances, where the budget is under $400,000 time required for approval can be reduced by programing the project under minor construction procedures if it can be demonstrated that the project is "self-compensating." To qualify, anticipated savings in maintenance and operational costs within three years after completion must at least balance higher initial project costs.

1:213 WAIVERS

In order to obtain advantages of IBS methods, waivers (formally referred to as deviations) may be needed for some of the military regulations, standards or procedures which were designed to accommodate conventional projects but which tend to inhibit IBS processes.

Deviations can be obtained under the general provision 1-109.1, which states:

> "ASPR is not intended to stifle the development of new techniques or methods of procurement. Innovation to attain desirable objectives will occasionally necessitate deviation from ASPR, and it is *the responsibility of the contracting officers* to request such deviations whenever they are required in the best interest of the government." (Emphasis added).

Deviations include omissions or variations from required contract clauses, alterations of standard D. D. forms exceeding limitations imposed by the appropriate authorities, and the modifications of official policies. Deviations affecting more than one contract or contractor will not be allowed unless approved in advance by ASD (I & L). However, the unanimous approval by the ASPR committee constitutes approval by the Secretary of Defense on all matters except those involving major policy. Approval of requests for waivers of procedure depends largely on the substantiation. Requests should contain:

ASPR requirement involved;

Description of the required deviation and circumstances under which it will operate;

The intended effect of the deviation;

Additional relevant documents, forms or clauses;

The period of time for which the deviation is required, and

The reasons for the deviation.

Written notice should be given well in advance of the effective date for such deviation, unless exigency of the situation requires immediate action.[1]

The following are examples for which deviations have been granted for previous IBS programs, plus notes on how to accomplish them:

Statutory Cost Limitations: Apply to DAEN-MCC after priced proposals are received.

Construction Criteria or Guide Specs: Apply to DAEN-MCE at the beginning of programming. If some prescriptive requirements are too restrictive, they should be named individually.

Audit of A/E Firm: Although C.O.s are authorized to waive this requirement, this action should be noted in writing for the record and/or higher authorities informed. If an audit has been accomplished within the past twelve months, it is acceptable.

Concept Design: A waiver of concept designs is necessary for all strategies except *Fixed Design;* request authority for the other strategies from DAEN-MCC.

Authority for Negotiating A/E Contracts in Excess of $100,000.: Apply to the district officer (ASPR 18-402.3). This technicality may be avoided on aggregated projects if individual project fees average less than this stated amount.

Extra-Jurisdictional Project Aggregation: If the project extends beyond the jurisdiction of one district office, obtain authority from OCE to coordinate directly with the concerned offices without going through OCE.

[1]ASPR 1-109.5

Required Percentage of Work: To allow some leading design/build firms to compete for the contract, a waiver should be requested to permit a reduction in the required minimum percentage of work the contractors should execute themselves (for housing, the minimum is 15%; other construction is 20%). Many design/build firms execute only 10-15% of the work themselves, but still produce good results through careful coordination of the sub-contractors. The standard clause of ASPR has been interpreted to require the quality control organization of the prim contractor to be responsible for the work of all subcontractors, including site work.[4] [6]

[4] ASPR 18-104

[5] ASPR 7-603.15

[6] Ft. Knox RFP, Amendment No. 2

SECTION TWO

THE SELECTION OF THE PROCUREMENT OPTION

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1:220 THE PROCUREMENT OPTIONS

IBS are pre-designed products whose economical and practical procurement are dependent upon a procurement method compatible with the design-build strategy. The procurement method is so interdependent with the entire delivery process and design strategy that the success of one usually requires the appropriate use of the others. Traditionally, the procurement method known as Formal Advertising has been the time-honored method. Other methods have evolved in an attempt to duplicate private industry's success in procuring IBS. Unlike private industry, however, the Government must maintain a unique posture of fairness to competitors and accountability to the public. Listed below are the three procurement options which represent the best methods to use in procuring IBS.

1 — One-step Competitive Negotiations
2 — Two-step Formal Advertising
3 — Formal Advertising

1:221 ONE-STEP COMPETITIVE NEGOTIATION

One-step Competitive Negotiation is not negotiation as commonly understood, but rather is a competitive tool wherein competing technical proposals are sought by a formal solicitation or advertisement. The responding proposals are subject to negotiation proceedings and then after the "best and final" offer they are then evaluated pursuant to a predetermined scoring scheme wherein "initial cost" is but one factor to be considered. Other factors that can be given weight include the technical competence of the proposal, physical appearance, and life-cycle-costs.

The One-step procurement method consists of the following procedures :

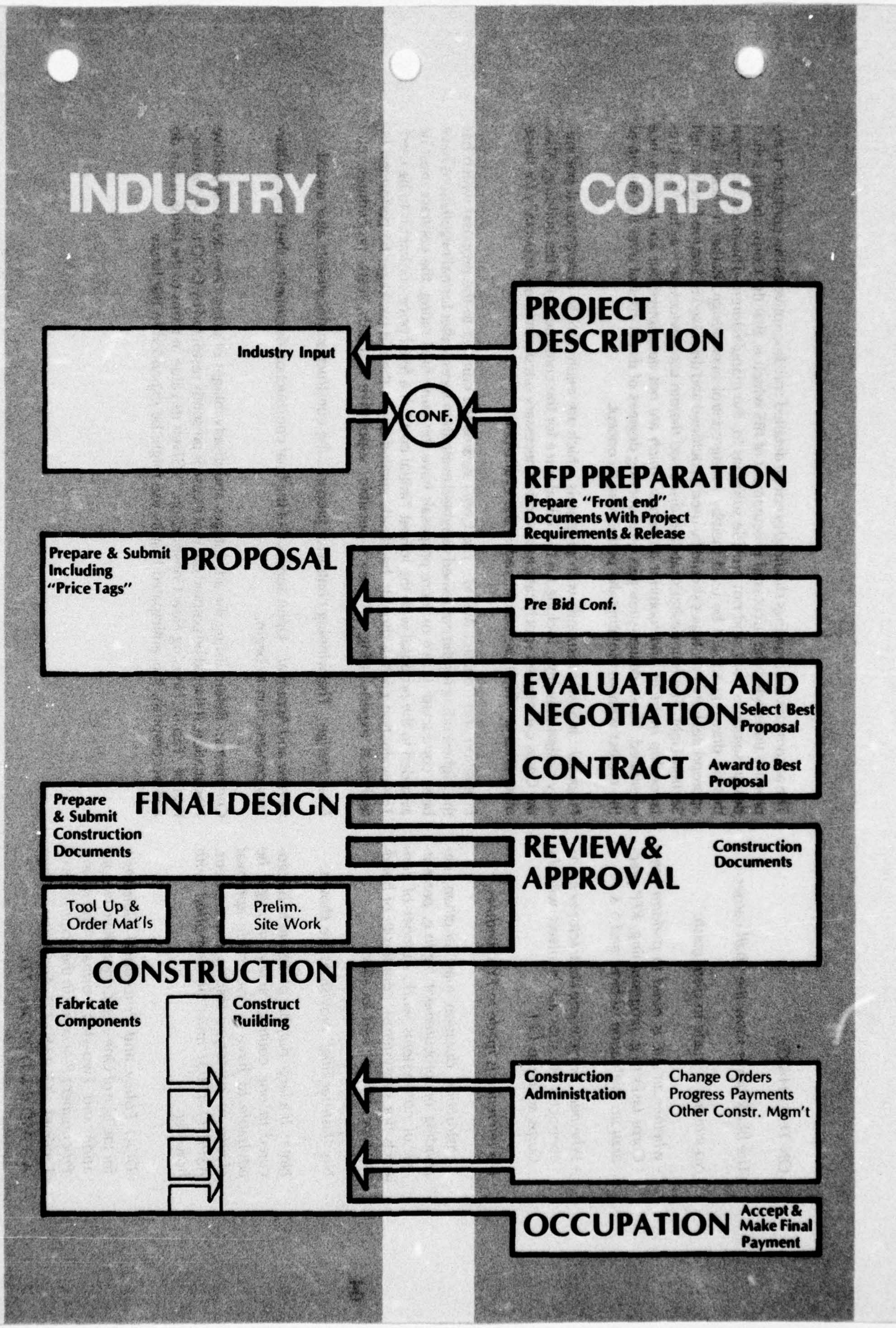
Document Preparation: The Corps should describe its project needs in such a way as to encourage competition and minimize costs.

See ASPR1-1201.
"Plans, drawings, specifications...shall... describe the supplies and services in a manner which will encourage maximum competition..."

Traditionally the Corps has used descriptive specifications coupled with detailed drawings to communicate its needs. This, however, conflicts with the pre-engineered nature of IBS. Assuming that a manufacturer has developed an "off-the-shelf" product which functionally meets the Corps' needs, communicating project needs in descriptive terms means that: he may not compete; if he competes, he will probably have to retool, and employees might require additional training. The retooling will require amortization and, therefore, increase costs, while the training will somewhat negate the cost-saving advantages created by the "Learning Curve Phenomenon."

See sections 1:300 through 1:305 for a more complete analysis of the different ways to specify needs.

Because of this, project needs should be communicated, whenever possible and practicable, by performance specifications. Performance specifications state requirements in terms of function wherein a solution is sought which solves a problem or meets a criteria. Many, perhaps an infinite, number of design solutions can perform the required functions. Requesting a design solution is of course the opposite of providing a design solution as is done for traditional construction. However, it is probably the only way to effectively and economically procure IBS.



ONE STEP COMPETITIVE NEGOTIATIONS

ON THE CHART:

The black boxes show the "ball carrier."

No attempt is made to distinguish:

– whether an A/E is hired to perform some Corps tasks (e.g. programming, RFP preparation, evaluation of bids, and S & I):

– Whether a single prime contractor or multi-contracts with subs are involved, with the Corps acting as CM.

No reference is made to FY schedules.

Construction duration may lengthen, depending on procurement lagtime, percentage of non-systems work, number of contracts (for subsystems), complexity of building type, climate and location.

No "fast-tracking" provisions are shown.

Note: If a large number of IBS are to be procured in one contract action, it might be advisable to have a first article approval clause or prototype-testing requirement. ASPR (1-1903) must be complied with however.

[1]DOD Policy and Procedural Guidance for the Use of One-step Competitive Negotiation and Two-step Formal Advertising Procurement Procedure in the acquisition of Facilities. (ER 1180-1-7 Appendix A, Page A-3 ASD (I & L) 20 Dec. 73).

The accompanying drawings should also not be detailed and descriptive as this contradicts the premise underlying the successful procurement of IBS which is, that the Corps should solicit design solutions from, and not provide solutions to, the manufacturers. This does not mean that no drawings should be used thereby losing control over design. Rather it means that appropriate design strategies should be used as outlined and discussed in Section Five through Section Eight. The four design strategies discussed therein use devices such as functional relationship matrices and footprint drawings which are not descriptive but are performance orientated. These design-strategies offer varying degrees of direct control over the design of the project without violating the performance concept.

Proposal: Industry responds with proposals which are equivalent to conventional preliminary design drawings; included is the initial price for the construction of the building. Also, the Corps can request specifications and other necessary documentation, especially for those other criteria which are considered in the evaluation.

Evaluation and Contract Award: The Corps awards the contract to the proposal which has the highest rating for the combined weighted evaluation factors after formal negotiations have been conducted. If two or more proposals have the same final rating, the contract must be awarded to the proposal with the lowest "initial cost," if a fixed price contract is to be used. The evaluation criteria should: be clearly spelled out in the bid package; be performed by technical experts using, whenever possible, supportive manuals, tests, procedures, etc.

Final Design: The winning contractor prepares the construction documents after award.

Review and Approval: Upon approval of the final construction documents, the Corps authorizes construction to begin.

Comments: Before listing the advantages and disadvantages of using One-step Competitive Negotiation, it should be pointed out that its use is presently restricted by DOD to the construction of "Family Housing New Construction."[1] Given its value in terms of the things it can do and accomplish, it is anticipated that its use might be expanded in the future.

Advantages of One-step Procurement:

(1) Because needs may be described in non-restrictive performance terms, this method allows the consideration of various design solutions. IBS, therefore, can be procured effectively and efficiently through the use of this method.

(2) Unlike other methods, this method allows the use of not only fixed-price contracts but also cost-reimbursement contracts or incentive contracts. In times of high inflation, and other uncertainties, fixed-price contracts are often impractical, especially for multi-year contract actions.

(3) This method, recognizing that initial-cost doesn't always mean true cost, gives value to other factors such as life-cycle costs, aesthetics, and technical competence by giving each a percentage weight in the evaluation. It has long been recognized that these factors are nearly of equal importance to initial-cost. Life-cycle energy costs are especially important in view of expected shortages of fossil fuels. One Federal project had an estimated 25% savings in the building's energy needs, by considering and giving value to life-cycle costs.[1] (This same project estimated that initial cost is only ⅓ of the total or life-cycle cost of a building.) Basing an award on low initial cost alone discourages, or at least doesn't encourage efficiencies of energy or maintenance and operation.

[1]GSA Contract, 8 March 1973, for three Social Security Administration Buildings.

(4) Because percent evaluations can be given to factors other than initial cost, this method requires much less time and effort and difficulty in preparing specifications and drawings than Two-step Formal Advertising. Since Two-step can only consider initial cost for the final award, if it considers other factors such as life-cycle costs it must include them in the specifications such that a manufacturer can be excluded as non-responsive to the minimum threshold requirement of the solicitation. A successful consideration of factors other than initial costs requires precise, all-inclusive performance specifications accompanied by an accurate, reliable evaluation process if Two-step Formal Advertising is used.

(5) One-step negotiation appears to be more popular among manufacturers than Two-step Formal Advertising.[1]

[1]*CERL*, Study on Potential Use of Industrialized Building for the Department of the Army, *1971*, *Vol. 2*, *pg. 2-49*, *fig. 6*.

Disadvantages of One-step Procurement:

(1) As pointed out earlier, its use is presently limited to one building type.

(2) Even though awarding a contract on initial cost alone has obvious disadvantages, its advantages are simplicity and apparent fairness. Basing an award on factors in addition to initial costs requires more effort and ostensibly presents somewhat more potential for fraud and favoritism, though this is debatable.

(3) Like Two-step Formal Advertising, this method appears to require a contractor to either have design-capabilities or the ability to acquire within a short time such design-capabilities. It should be noted that many contractors, especially small concerns, don't have in-house design-capability. Secondly, requiring a design solution makes bidding a more expensive risk than conventional contracting; possibly even a prohibitive risk among small contractors.

Conclusion: One-step Competitive Negotiation is an excellent procurement method to use in acquiring IBS. It has great flexibility in terms of such things as the type of contract to use and what factor/s to base the award on. Its use will hopefully be less restricted in the near future, as its potential benefits appear to greatly outweigh its disadvantages (most of which appear correctable with supplementary regulation).

1:222 TWO-STEP FORMAL ADVERTISING

Two-step Formal Advertising bridges the public accountability of formal advertising with the versatility of One-step Competitive Negotiation. In short, it is a procurement option where technical proposals are received without dollar bids, and evaluated against predetermined criteria. Those firms whose proposals were deemed "responsive" are then asked to submit a bid to construct the facility according to their own proposal. The contract is awarded to the lowest bidder. This method should only be used, per ASPR 2-501, where "inadequate specifications preclude the use of conventional formal advertising." This means that where it is probable that there will be wide variations in the design solutions, or that where the project needs are unusual and require a technical solution, it is appropriate to use the Two-step Formal Advertising procurement method.

The Two-step Formal Advertising method consists of the following procedures :

Document Preparation: As in the use of One-step Competitive Negotiation, the Government should describe its needs in such a way as to encourage competition and minimize costs. This requires the maximum effective use of performance specifications coupled with one of the four design strategies listed in Section Five through Section Eight. Since factors other than initial cost cannot currently be considered in awarding the contract, in the Military, these factors, if they are deemed important, must be expressed as performance specifications. To draft all-inclusive performance specifications which insures adequate quality, incorporates life-cycle-cost factors, and promotes aesthetic considerations requires considerable expertise and experience.

Proposal: Based on the above documentation, industry submits its designs in the form of "Technical Proposal" without bids.

Evaluation: Proposals are evaluated by a team of technical experts to determine if they are "responsive." If a proposal could be made responsive with only minor modifications, the proposer should be given a chance to make such minor modification. It should be emphasized that since the contract must be awarded to the "responsive" contractor with the low bid, care should be exercised at this step to accurately evaluate responsiveness.

Bids: Industry responds in the second step with pricing based on their own proposal.

ON THE CHART:

The black boxes show the "Ball carrier."

No attempt is made to distinguish:

- *whether an A/E is hired to perform some Corps tasks (e.g. programming, RFP preparation, evaluation of bids, and S & I);*
- *whether a single prime contractor or multi-contracts with subs are involved, with the Corps acting as CM.*

No reference is made to FY schedules.

Construction duration may lengthen, depending on procurement lagtime, percentage of non-systems work, number of contracts (for subsystems), complexity of building type, climate, and location.

No "fast-tracking" provisions are shown.

Contract Award: The contract is given to the responsive proposer with the lowest bid, who is a "responsible" bidder.

Final Design: The winning contractor prepares complete technical calculations and detailed construction drawings after award.

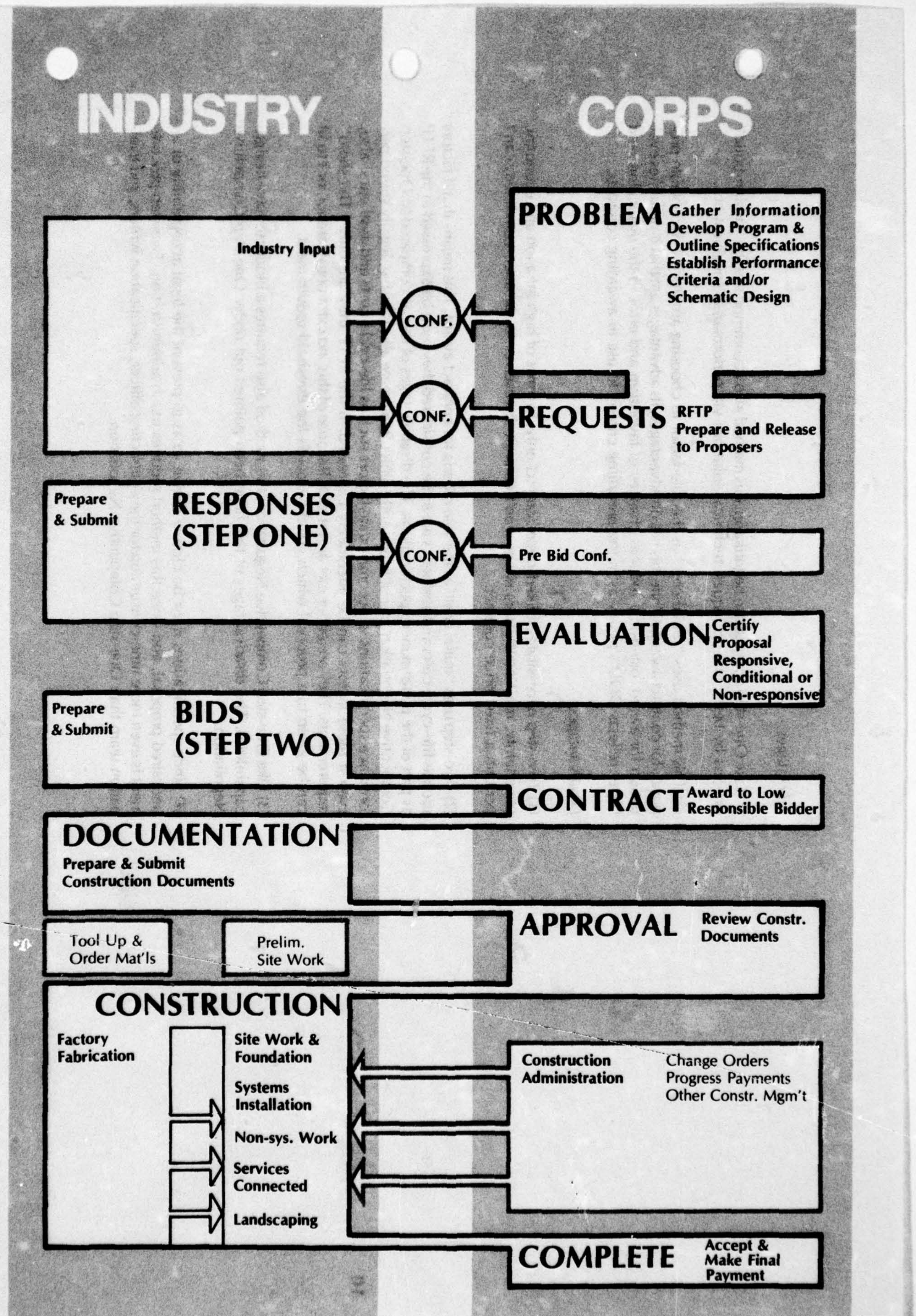
Review and Approval: Upon approval of these final construction documents, the Corps authorizes construction. Note that first article approval[1] might be used if a sufficient number of products are being procured in one contract action.

Comments: Like One-step Competitive Negotiation, Two-step Formal Advertising is also limited by DOD to certain uses.[2] Two-step is presently allowed only for, absent authority from the Assistant Secretary of Defense, various types of "industrial" facilities, commissaries, and "various facility types when performance specifications *must* be utilized to accommodate indistrialized construction (building system) components and concepts." This last limitation is, in the majority of instances, not really a limitation at all. ASPR 1-1201 mandates that specifications and drawings should encourage competition and not be "unduly restrictive." Two-step Formal Advertising was created to use performance specifications where adequate competition could not be achieved *with descriptive specifications*. If descriptive specifications are adequate to describe needs and allow for competition then the Formal Advertising, or conventional, method of procurement is sufficient. Given the pre-engineered nature of IBS, and the fact that *no two IB products* are likely to be identical, the only way to procure these IBS without being "unduly restrictive" is to communicate needs in terms of function via performance specifications.

Therefore, since the successful procurement of IBS almost always necessitates the use of performance specifications, Two-step Formal Advertising can, consistent with DOD's recent policy guidelines, always be used for the procurement of most IBS. If performance specifications are not necessary-e.g., if there were many IB manufacturers with identical design solutions; or if there were no design solutions by any IB manufacturer — then there would be little need to use Two-step Formal Advertising.

[1]*ASPR1-1900*

[2]*DOD Policy and Procedureal Guidance For the Use of One-step Competitive Negotiation and Two-step Formal Advertising Procurement Procedures in the Acquisition of Facilities. (ER 1180-1-7. Appendix A, page A-3, ASD (I & L), 20 Dec. 73).*



TWO-STEP FORMAL ADVERTISING

Advantages:

(1) Like One-step competitive negotiation, this method also accommodates the "design-build" process by being able to request technical solutions via performance specifications.

(2) This method uses "initial cost" as the sole factor in choosing among the acceptable proposals for contract award. While this has disadvantages, its advantages are that it simplifies evaluation for award, ostensibly reduces chances of favoritism and error in the evaluation, and better reflects DOD's policy as to the prevailing criteria to use in awarding contracts.

Disadvantages:

(1) Two-step necessitates a fixed-price contract only. In times of high inflation and economic uncertainty, most contractors either won't commit themselves to, or once commited, can't perform a fixed price contract.

(2) Two-step uses "initial cost" as the sole criteria for contract award. This means that if factors such as life-cycle costs and aesthetics are to be considered they must be expressed in the RFTP as part of the performance specifications. The disadvantages of this as compared to One-step Competitive Negotiation are: it is presently difficult to create all-inclusive, legally sound performance specifications to accommodate factors such as life-cycle-costs and aesthetics; also, even if these factors can be adequately expressed in the RFTP they are only "Threshold" requirements. They are either met or not met. Because of this, no extra consideration or credit can be given to a proposal which greatly exceeds the threshold requirement.

(3) Like One-step Competitive Negotiation, this method also requires a bidder to have design-capabilities. The disadvantages of this have been pointed out under One-step Competitive Negotiation.

(4) Since specifications must be closely drawn so as to prevent the legal acceptability of an undesired proposal, and since this method requires much administration, Two-step procurement is even more time-consuming for the contracting officer, specification writers, and evaluation team than One-step Competitive Negotiation.

Conclusion: Like One-step Competitive Negotiation, Two-step Formal Advertising is a procurement tool quite appropriate for the acquisition of IBS. Two-step is not, however, as flexible a tool as One-step Competitive Negotiation, but, until the restrictions on One-step are removed or reduced, Two-step is the only procurement method available to economically and effectively accommodate the unique pre-requisites that IBS present. *E. g.*, in general, most IBS have already developed design solutions. To accommodate the various existing design solutions, the project needs must be stated in terms of function. Only One-step Competitive Negotiation and Two-step Formal Advertising allow for needs to be described in terms of function, since they are the only design/build methods authorized for use.

Note: "Design" solution here does not necessarily mean building plans or overall building design but technical solutions, and the use of proprietary products or details.

ON THE CHART:

The black boxes show the "ball carrier."

No attempt is made to distinguish:

- whether an A/E is hired to perform some Corps tasks (*e.g.* programming, RFP preparation, evaluation of bids, and S & I);
- whether a single prime contractor or multi-contracts with subs are involved, with the Corps acting as CM.

No reference is made to FY schedules.

Construction duration may lengthen, depending on procurement lagtime, percentage of non-systems work, number of contracts (for subsystems), complexity of building type, climate, and location.

No "fast-tracking" provisions are shown.

1:223 FORMAL ADVERTISING

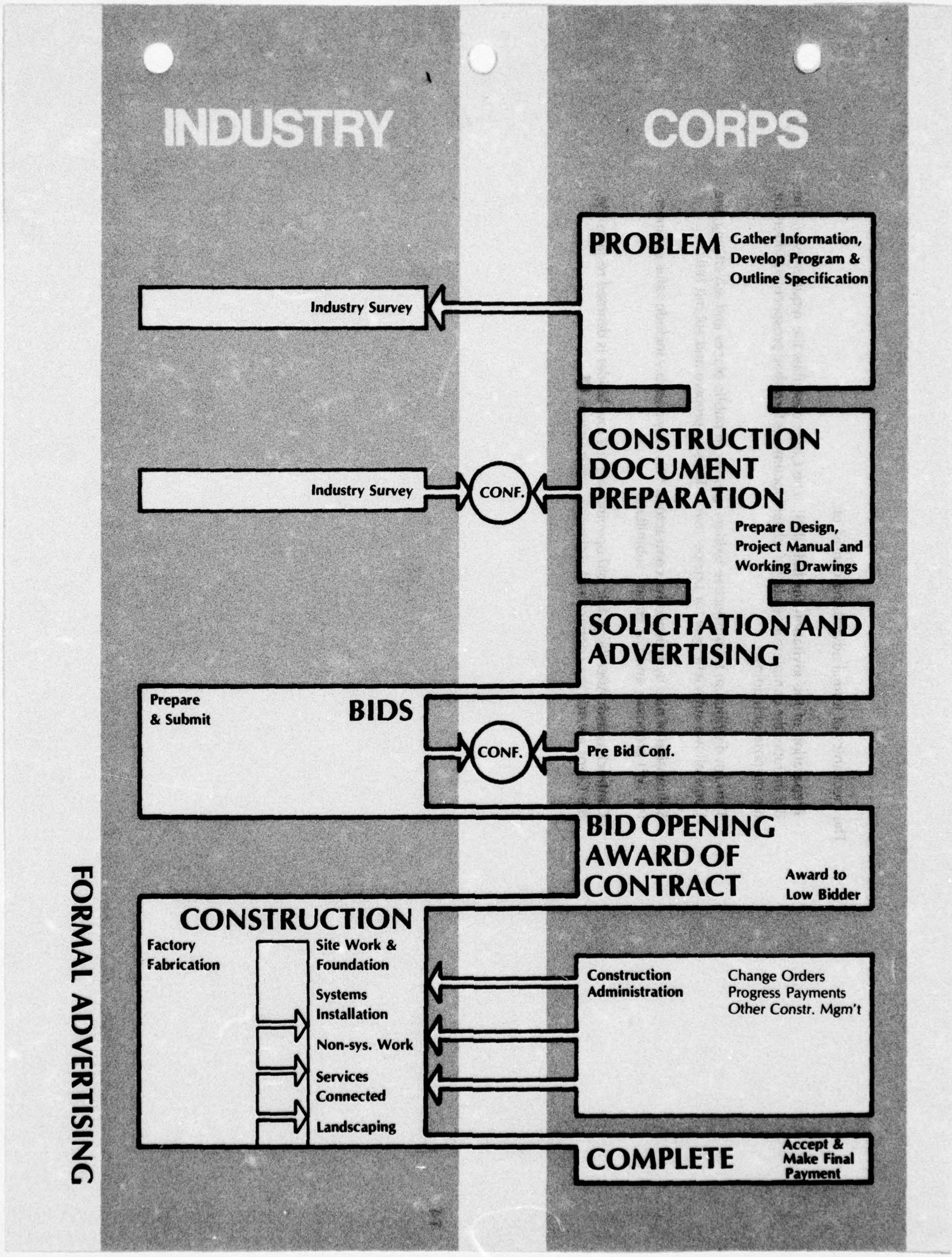
Formal advertising may be used where:

- A complete and realistic specification or purchase description can be made;
- Multiple suppliers are known to be willing and able to compete effectively for the work;
- The selection of a successful bidder can be made on the basis of price alone; and
- Sufficient time exists to prepare a complete statement of the owner's needs plus the terms upon which he will do business, as well as time to carry out administrative procedures.

Unlike *Two-step, formal advertising* does not require a bidder to have design capabilities. Also, the attributes of the owner's having a fixed price are well-known. Normally, this procurement option requires a design/bid/build approach, in that the government advertises exactly what it wants built, and industry has to bid what it must charge for that precise product.

Disadvantages of using formal advertising with IBS are:

- Lower quality facilities may result; an inferior building may well be delivered at the "cheapest price" because savings on the initial cost may quickly be offset by ongoing costs;
- Incentives cannot be provided for earlier delivery or higher quality if cost is the sole criterion for award. Further, a fixed-price contract, in a time of extreme inflation, means that many contractors won't commit themselves (or can't perform once committed);
- In not being able to accommodate performance documents, formal advertising cannot encourage new products, techniques or relationships.
- Since it is a design/bid/build process, it does not allow pre-engineered, industrialized buildings to effectively compete with conventional products except in the following situations: 1) If all available off the shelf industrialized building systems are identical in every detail (materials, dimensions, etc.) 2) Unless there are no off the shelf products in existance in which case manufacturers would lose no money in following the predetermined design.


INDUSTRY
CORPS
PROBLEM
Gather Information, Develop Program & Outline Specification
Industry Survey
CONSTRUCTION DOCUMENT PREPARATION
Prepare Design, Project Manual and Working Drawings
Industry Survey
CONF.
SOLICITATION AND ADVERTISING
Prepare & Submit
BIDS
CONF.
Pre Bid Conf.
BID OPENING AWARD OF CONTRACT
Award to Low Bidder
CONSTRUCTION
Factory Fabrication
Site Work & Foundation
Systems Installation
Non-sys. Work
Services Connected
Landscaping
Construction Administration
Change Orders
Progress Payments
Other Constr. Mgm't
COMPLETE
Accept & Make Final Payment
FORMAL ADVERTISING

The mechanics of formal advertising consist of:

Preparation of the invitation for bids (IFB): The Corps describes the requirements. The IFB includes the complete assembly of related documents furnished prospective bidders for the purpose of bidding;

Through distribution to prospective bidders, posting in public places and advertising, the Corps allows sufficient time for prospective bidders to prepare and submit bids.

Submission of bids by prospective contractors: This may possibly include *value engineering* (VE) proposals and "or equal" submittals.

Contract award: After the public bid opening and the low bidder is deamed responsible, the Corps awards the contract and authorizes construction. ■

SECTION THREE

THE SELECTION OF A/E SERVICES

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1:231 INFORMATION ON A/E SERVICES

Since the A/E services required for IBS work are significantly different from those needed for conventional work, design professionals should be selected with unusual care. CERL maintains a data bank (CERL/TIBS) of firms qualified in building systems work.[1]

CERL-FHM, Box 4005
Champaign, Illinois 61820
Tel: (217) 352-6511

1:232 SELECTION CRITERIA

The following criteria should be used in selecting A/E professionals for IBS work:

- experience with industrialized building systems;
- design experience with the building type required;
- knowledge of performance and government specifications;
- acquaintance with CORPS procurement procedures;
- a capability for flexible teamwork and prompt document preparation;
- a record of excellence in site and architectural design.

See also
– AIA Document B551 (Statement of the Architect's Services);
– AIA Publication "The Architect-Engineer and the Military Services";
– ASCE Manual 45;
– ASPR 18-401 through 18-405.

– AIA Document B551 (Statement of the Architect's Services);

1:233 THE SCOPE OF A/E SERVICES REQUIRED

For conventional projects, an architect will spend most of his time developing detailed construction drawings. With IBS work, these services are no longer needed. However, other specialized services are required instead. These may include:

For all projects:

- authentication of design criteria;
- site design, or the development of means for controlling proposer's site design;
- development of prototype documents, meshing them to goals;
- preparation of the RFP/RFTP with drawings and prescriptive/performance specs, possibly including life-costing, evaluation criteria and multiple contract packages;
- assistance on the evaluation of the proposal;
- provision of cost estimates, updated at each stage of design.

02

See also:

- *AIA Documents B131, B132, B231, B331, B551;*
- *ASPR 3-400 Series,* Types of Contracts;
- *ASPR 3-809,* Contract Audit As A Pricing Aid;
- *ASPR 7-600 Series, Clauses for Construction and Architect-Engineer Contract*
- *ASPR 18-303,* Profit or Fee *(under Negotiations);*
- *ASPR 18-402,* Selection *(under Architect-Engineer Selection Procedures);*
- *DD Form 633,* Contract Pricing Proposal *(for AE submission).*

Cost-Based Compensation Guidelines For Architectural and Engineering Services, New York State Council on Architecture, 810 7th Avenue, New York City 10019

Compensation Management Guidelines For Architectural Services: A Manual on Cost-Based Compensation (American Institute of Architects).

For Certain Other Projects:

- identification of appropriate IBS producers;
- development of alternative character sketches or mass models to convey design goals to proposers;
- arrangement for pre-proposal conferences;
- preparation of CPM/PERT/LOB networks, scheduling time for industry contact, document reviews, production and coordination of trades;
- supervision of construction progress;
- preparation of conventional documents (if needed as a contingency "fallback" position);
- revision of payment techniques to allow for completed factory fabrication;
- arrangement of management/industry meetings during construction.

1:234 THE COST OF A/E SERVICES

The cost of the A/E services varies considerably, depending on project size and the scope of services required. The fee should relate directly to the services to be carried out and should not be based on a percentage of the construction costs. Normal fee guidelines should be used (e.g., direct hourly labor costs, general and administrative percentages, travel and subcontracts) and appropriately modified to take into account the changes of scope and character resulting from the use of industrialized building methods.

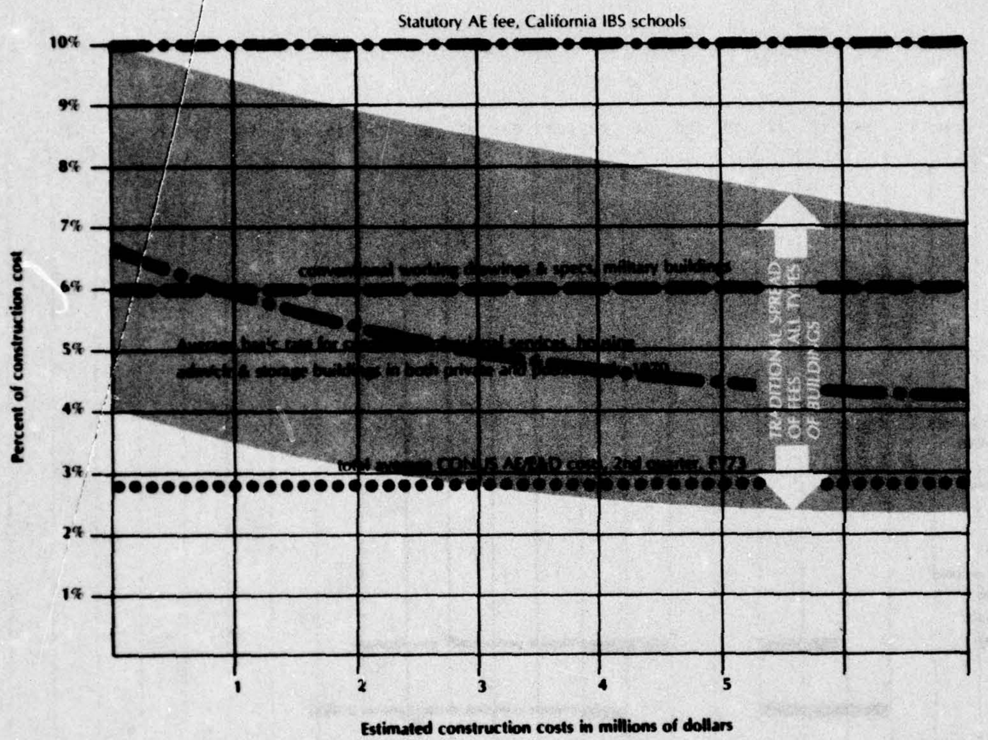
The cost of the professional services required will vary with the strategy selected.

Fixed Design: The A/E fees should be the same as, or more than normal because of the need to accommodate the various systems, in addition to developing plans for the building.

Footprint: The A/E fees should be the same as normal because, although complete working drawings are not required, there are other detailed tasks which call for his professional input.

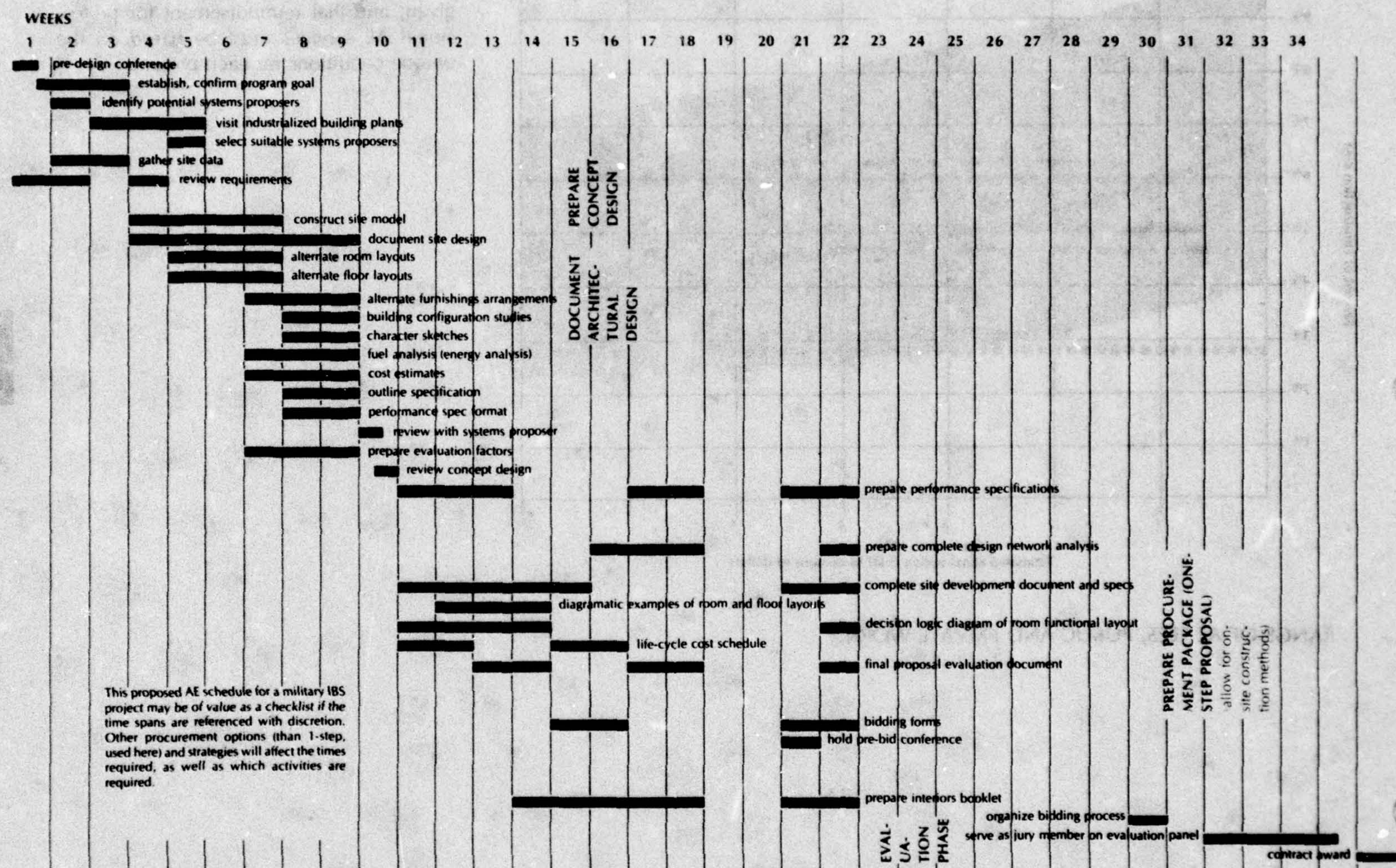
Sequential: The A/E fees should be less than normal; however, the scheduling considerations require special A/E attention.

Package: The A/E fees should be much less than normal because most of the A/E basic services are assumed by industry. ■



RANGE OF AE FEES, PUBLIC AND PRIVATE WORK

This graphic compilation of fees serves only to show that specific guidance cannot be given, and that reimbursement for professional AE services must be based on the *unique conditions for each project.*



This proposed AE schedule for a military IBS project may be of value as a checklist if the time spans are referenced with discretion. Other procurement options (than 1-step, used here) and strategies will affect the times required, as well as which activities are required.

SECTION FOUR

THE SELECTION OF THE STRATEGY

TABLE OF CONTENTS

1:240 SCOPE

In this section the factors to be taken into account in selecting an appropriate strategy are presented. To simplify the selection process, question networks were developed which can be used to match the appropriate strategy with a particular set of requirements. Separate question networks have been developed for the three main building types.

The path to follow will vary according to the particular building type, the building systems available, and other conditions peculiar to the project. To detèrmine how to proceed, refer to the building type involved in your project:

Housing

If your building type is housing refer to Sub-Section 1:241. Use the question network found there to determine which strategy will be best suited for use on the project. The questions in the network are based on the building type, the program information, and the available building systems.

Administrative/Classroom

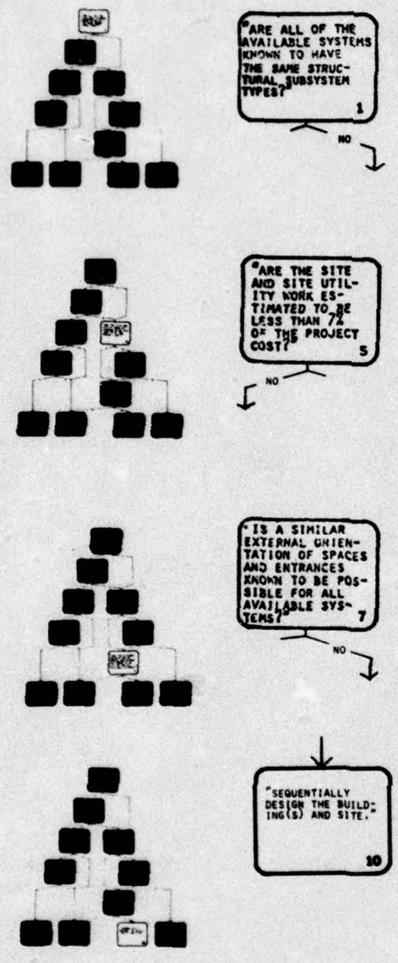
If your building type is administrative/classroom refer to Sub-Section 1:242. Use the question network found there to determine which strategy will be best suited for use on the project. The questions in the network are based on the building type, the program information, and the available building systems.

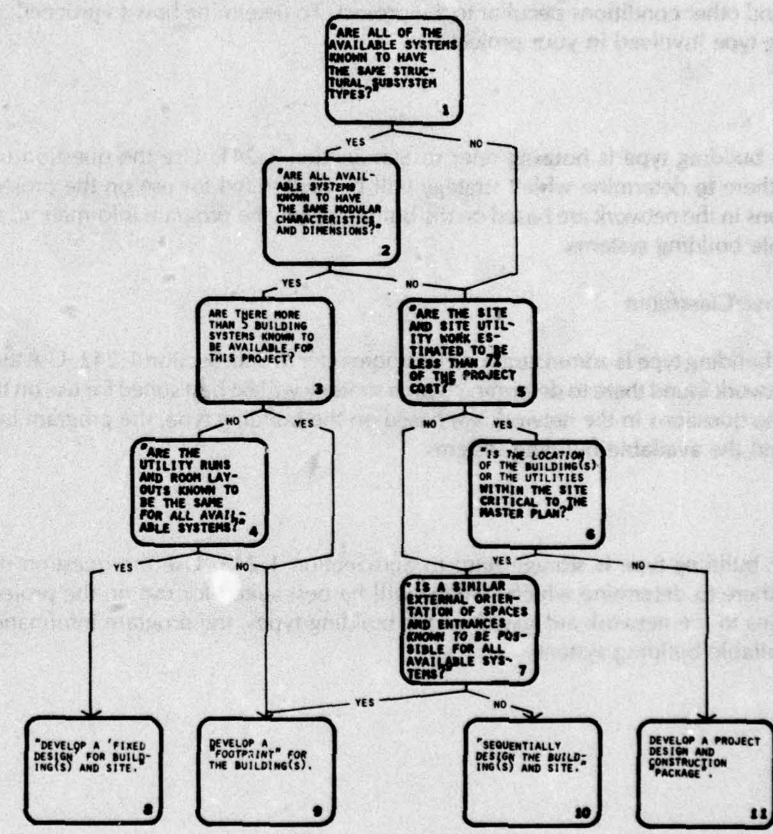
Storage

If your building type is storage refer to Sub-Section 1:243. Use the question network found there to determine which strategy will be best suited for use on the project. The questions in the network are based on the building types, the program information and the available building systems.

1:241 STRATEGY SELECTION: HOUSING

Below is a network of questions to be used in determining which strategy will encourage the maximum competition for construction of the project. Proceed through the network as illustrated on the marginal example until one of the possible strategies is reached. If it can be established that there are a large number of systems of each type available any of strategies 8 through 11 may be employed. In this case strategy 8 will afford the greatest control over the building design while strategy 11 will afford the greatest possible competition for the contract.





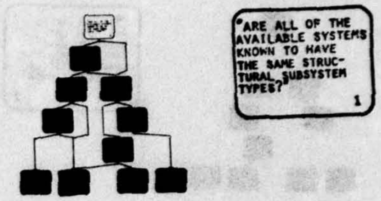
QUESTION NO. 1 - "ARE ALL[1] OF THE AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME STRUCTURAL SUBSYSTEM TYPE?"

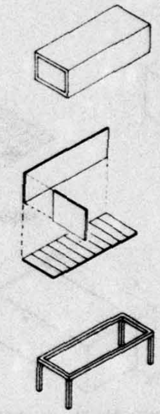
The available systems for a project may be either those identified by the CERL data bank or others which have been identified locally by the district. Those identified in the CERL data bank list the type of structural subsystems for each system as either volumetric; panel or frame and include information on modular characteristics and dimensions. Define locally identified subsystems by the criteria below:

> *Volumetric:* A structural subsystem composed of integrated wall, ceiling and/or floor which encloses a volume. Wood or metal stud-and-joist construction are used in many volumetric type structural systems.
>
> *Panel:* A structural subsystem which utilizes bearing and spanning panels to form spaces. (Wood or metal stud-and-joist construction to which skins have been applied to both faces and which are specifically intended to be erected as bearing and spanning panels such as plywood folded plates, are considered to be a panel structural subsystem).
>
> *Frame: A structural subsystem which utilizes a skeleton of columns, joists and/or beams, to* support floors and walls to create space.

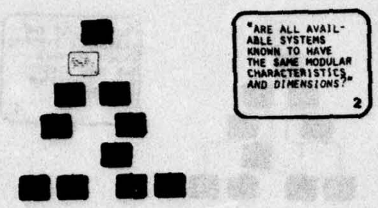
It must be possible to develop at least one structural-framing diagram (such as illustrated in the margin) which can be readily produced by all available systems in order to answer this question "Yes."

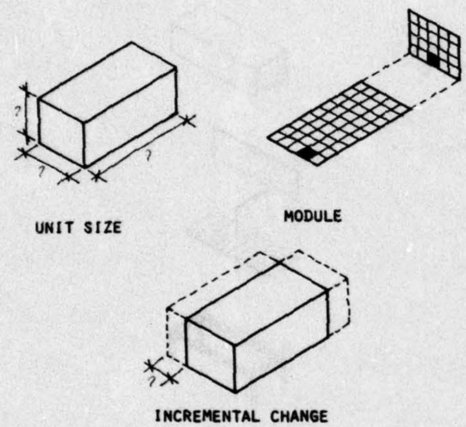
If the answer to question No. 1 is:
Yes . . . go to question No. 2
No . . . go to question No. 5





[1]Throughout this network "All" can be interpreted as an adequate number of administration/classroom systems remaining in contention to assure competitive proposals.





QUESTION NO. 2 - "ARE ALL AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME MODULAR DIMENSIONS?"

This information is available from the CERL data bank. For locally identified systems establish:

Standard unit size, *i.e.*, length, width and height?

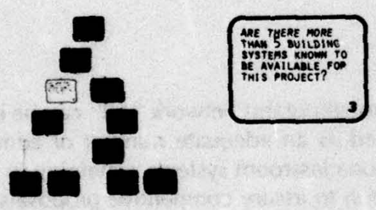
Standard or most used:

- modular size
- panel size (bearing and spanning)
- bay size
- floor-to-floor height

Determine what cantilevers are permitted.

Compare this information for similarity between the available systems. Where it is known to be possible to develop at least one suitable layout which can be readily accommodated by all available systems, answer this question "Yes". Where variations are found or adequate information is not available, answer this question "No".

If the answer to question No. 2 is:
Yes . . . go to question No. 3
No . . . go to question No. 5



QUESTION NO. 3 — "ARE THERE MORE THAN FIVE BUILDING SYSTEMS KNOWN TO BE AVAILABLE FOR THIS PROJECT?"

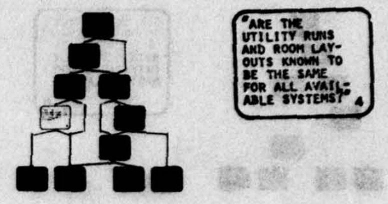
Where five or more building systems are available, it becomes increasingly difficult to adapt those systems to a building having a single fixed design configuration. If less than five are available, similarities and differences between systems may be identified more effectively, leading to the possibility of developing a single design to which all available systems can respond.

If the answer to question No. 3 is:
Yes . . . go to box No. 9
No . . . go to question No. 4.

QUESTION No. 4 - "ARE THE UTILITY RUNS AND ROOM LAYOUTS KNOWN TO BE THE SAME FOR ALL AVAILABLE SYSTEMS?"

It must be possible for all available systems to readily accommodate a single building layout to answer this question "Yes". To do this the available layouts must be the same or completely flexible. Obtain the information required to make this determination from the potential proposers. Where a single layout cannot be accommodated or insufficient data is available to make this determination, answer this question "No".

If the answer to question No. 4 is:
Yes . . . go to box No. 8
No . . . go to box No. 9

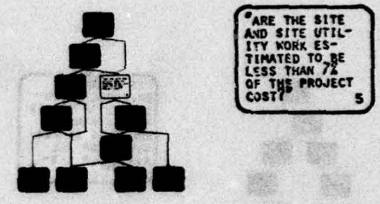


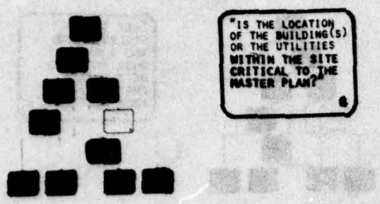
QUESTION No. 5 - "ARE THE SITE AND SITE UTILITY WORK ESTIMATED TO BE LESS THAN 7%' OF THE PROJECT COST?"

Beyond this percentage the following conditions often occur:

1. The site planning demands a high degree of design control, making it difficult to specify using performance requirements.
2. The building system contractor will not have the experience or resources necessary to adequately design the sitework, without incurring additional professional fees.

If the answer to question No. 5 is:
Yes . . . go to question No. 6
No . . . go to question No. 7

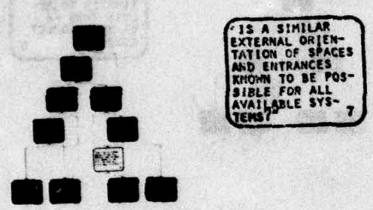




QUESTION NO. 6 - "IS THE LOCATION OF THE BUILDING(S) OR THE UTILITIES WITHIN THE SITE CRITICAL TO THE MASTER PLAN?"

Where the relationship of the buildings to existing or future facilities requires greater than average care in positioning the buildings, answer this question "Yes". Also, where utilities must be included in the project to service existing or future facilities and the site utility design is complicated by utility vaults, excessive site contour changes or existing site drainage problems, answer this question "Yes". Such conditions are most effectively conventionally designed by in-house personnel or an A-E consultant. Where these conditions do not exist, answer this question "No". Design requirements for less complicated layouts serving only the buildings being constructed can readily be specified in Performance/Prescriptive terms.

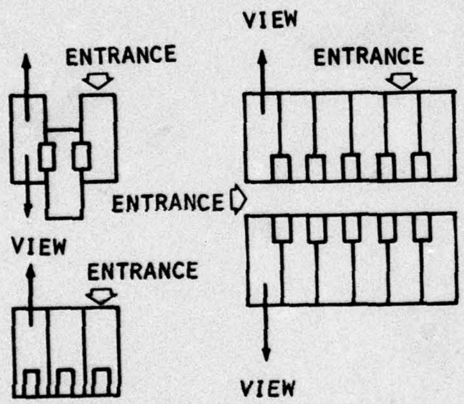
If the answer to question No. 6 is:
Yes . . . go to question No. 7
No . . . go to box No. 11



QUESTION NO. 7 - "IS A SIMILAR EXTERNAL ORIENTATION OF SPACES AND ENTRANCES KNOWN TO BE POSSIBLE FOR ALL AVAILABLE SYSTEMS?"

Obtain the information required to make this determination from the potential proposer.

Determine, for example, whether the dwelling units are double loaded about a central corridor and whether the entrance occurs on the same side as the main direction of view. Compare all available systems for similarity in these respects. Where such similarity does not exist or insufficient data is available to make this determination, answer this question "No". Entrances and exterior orientations which do not correspond throughout the available systems makes it difficult to develop a footprint with proper orientation and access to satisfy all of the available plan configurations.

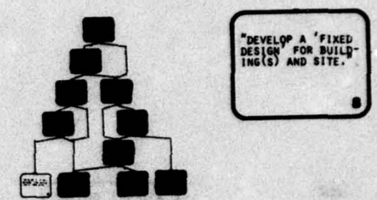


If the answer to question No. 7 is:
Yes . . . go to box No. 9
No . . . go to box No. 10.

Possible Strategies

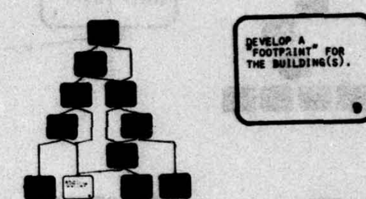
BOX NO. 8 - "DEVELOP A 'FIXED DESIGN' FOR BUILDING(S) AND SITE".

Turn to subsection 1:250 for a description of staff requirements and scheduling for this strategy, and to 1:340 for further description.



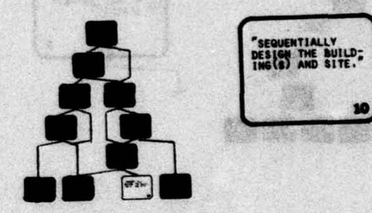
BOX NO. 9 - "DEVELOP A 'FOOTPRINT' FOR THE BUILDING(S)".

Turn to Subsection 1:260 for a description of staff requirements and scheduling for this strategy, and to 1:350 for further description.



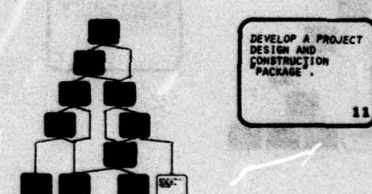
BOX NO. 10 - "SEQUENTIALLY DESIGN THE BUILDING(S) AND SITE".

Turn to Subsection 1:270 for a description of staff requirements and scheduling for this strategy, and to 1:360 for further description.



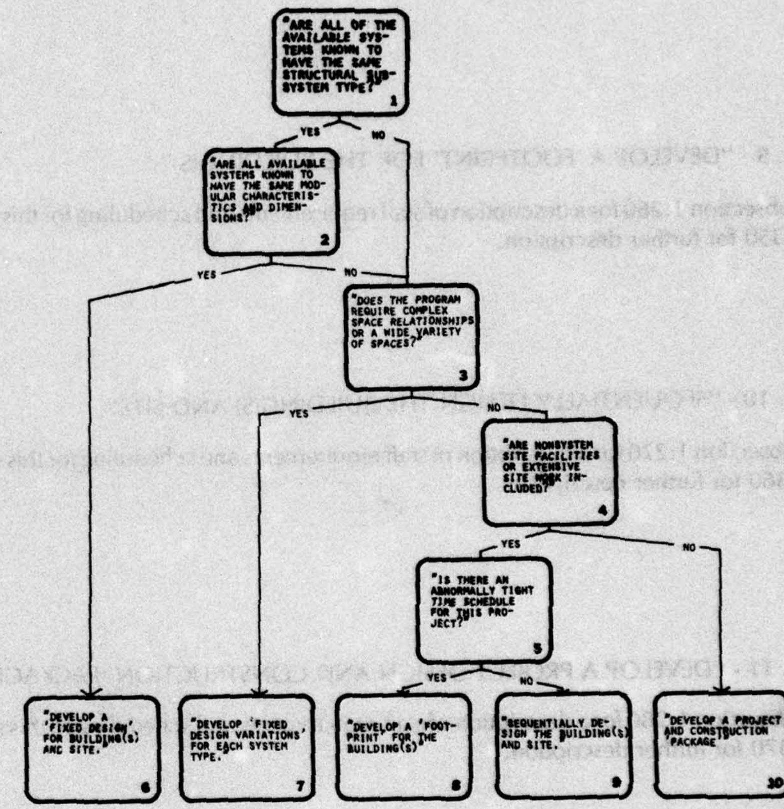
BOX NO. 11 - "DEVELOP A PROJECT DESIGN AND CONSTRUCTION 'PACKAGE'",

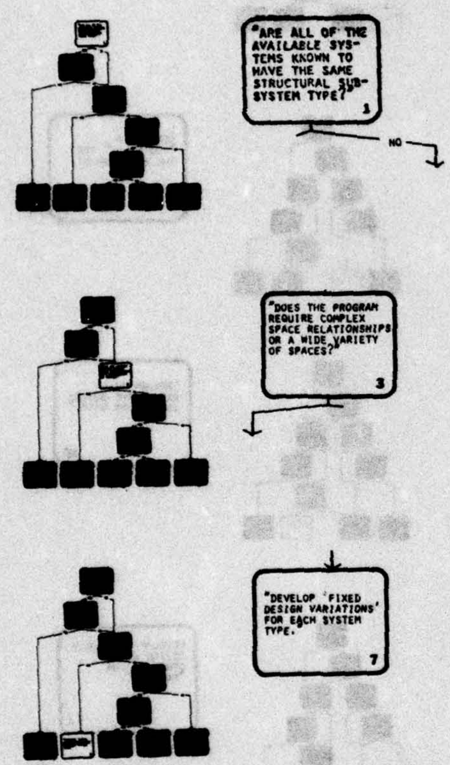
Turn to Subsection 1:280 for a description of staff requirements and scheduling fo this strategy, and to 1:370 for further description.



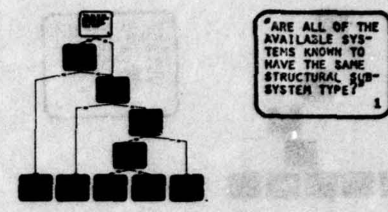
1:242 STRATEGY SELECTION: ADMINISTRATIVE/CLASSROOM

Below is a network of questions to be used in determining which strategy will be best suited for use on the project. Proceed through the network as illustrated in the marginal example.

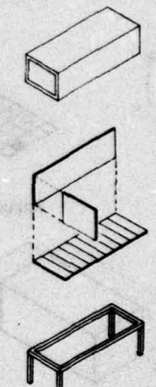




QUESTION NO. 1 - "ARE ALL OF THE AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME STRUCTURAL SUBSYSTEM TYPE?"



The available systems for a project may be those identified by the CERL data bank or see subsection 2:431 for others which have been identified locally by the district. Those identified in the CERL data bank list the type of structural subsystems for each system as either volumetric, panel or frame, and include information on modular characteristics and dimensions. Define locally identified subsystems by the criteria below:



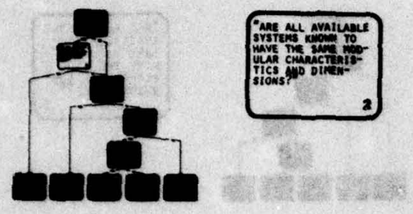
Volumetric: A structural subsystem type composed of integrated wall, ceiling and/or floor that encloses a volume. Wood or metal stud-and-joist constructions are used in many volumetric type structural systems.

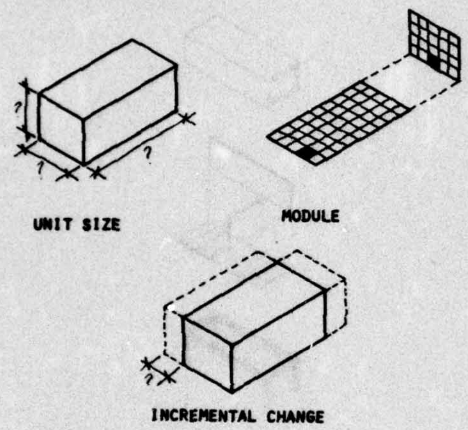
Panel: A structural subsystem type which utilized bearing and spanning panels to form spaces. (Wood or metal stud-and-joist construction to which skins have been applied to both faces and which are specifically intended to be erected as bearing and spanning panels such as plywood folded plates, are considered to be a panel type structural subsystem).

Frame: A structural subsystem type which utilizes a skeleton of columns, joists and/or beams, to support floor and walls to create space.

It must be possible to develop at least one structural framing diagram which can be readily produced by all available systems in order to answer this question "Yes".

If the answer to question No. 1 is:
Yes . . . go to question No. 2
No . . . go to question No. 3





QUESTION NO. 2 — "ARE ALL AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME MODULAR CHARACTERISTICS AND DIMENSIONS?"

This information is available from the CERL data bank. For locally identified systems establish:

Standard unit size, *i.e.*, length, width and height.

Standard or most used:

- modular size
- panel size (bearing and spanning)
- bay size
- floor-to-floor height

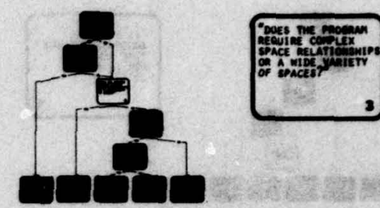
Determine what cantilevers are permitted.

Compare this information for similarity between the available systems. Where it is known to be possible to develop at least one layout which can be readily accommodated by all available systems, answer this question "Yes". Where significant variations are found or adequate information is not available, answer this question "No".

If the answer to question no. 2 is:

Yes. . . go to box no. 6
No . . . go to question no. 3

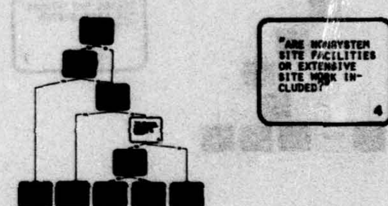
QUESTION NO. 3 - "DOES THE PROGRAM REQUIRE COMPLEX SPACE RELATIONSHIPS OR A WIDE VARIETY OF SPACES?"



Where the requirements for spaces and their desired relationship is complex, it becomes difficult to describe this in performance terms. For example, if a training facility is required to have fifteen similar classrooms and three office spaces all being of similar function, this would be considered a simple space relationship. If, however, several types and sizes of teaching spaces including a lecture hall, seminar rooms, and conference, laboratory, lounge space and a variety of office spaces which have complicated functional relationships to each other are included, this would be considered *complex*. Where the program is complex, it is better to transmit this information to the proposer via the traditional discussion with the interior designer rather than via the RFP/Proposal/Evaluation process. A "Yes" answer will allow for such discussion. However, when space requirements are not complex, their expression in performance terms will allow for easier adaption of the building system to the program requirements. If such is the case, answer this question "No".

If the answer to question No. 3 is:
Yes . . . go to box No. 7
No . . . go to question No. 4

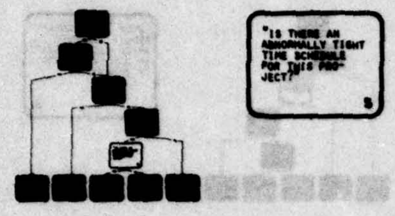
QUESTION NO. 4 - "ARE NONSYSTEM FACILITIES OR EXTENSIVE SITEWORK INCLUDED?"



To determine what parts of the program cannot be constructed using available building systems, a comparison should be made between the scope of the services and subsystems provided by the available building systems. If there are extensive non-system facilities such as swimming pools, storage tasks or unique training enclosures or if site work, including site utilities, exceeds 7% of the project budget, the question should be answered "Yes."

If requirements for extensive nonsystem facilities or sitework do not exist, then answer this question "No".

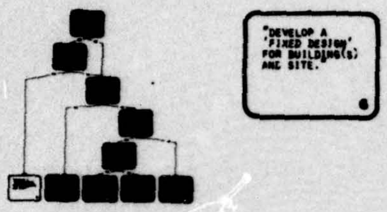
If the answer to question No. 4 is:
Yes . . . go to question No. 5
No . . . go to box No. 10



QUESTION NO. 5 - "IS THERE AN ABNORMALLY TIGHT TIME SCHEDULE FOR THIS PROJECT?"

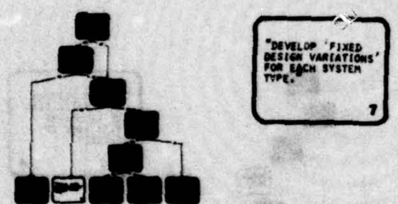
This question should only be answered "Yes" when the period between the time when the construction funds are expected to be made available and the required occupancy date is less than 66% of the normal time required by use of conventional construction methods.

Possible Strategies



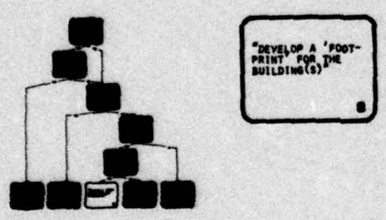
BOX NO. 6 - "DEVELOP A 'FIXED DESIGN' FOR BUILDING(S) AND SITE".

Turn to Subsection 1:250 for a description of staff requirements and scheduling for this strategy and to 1:340 for further description.



BOX NO. 7 — "DEVELOP FIXED DESIGN VARIATIONS FOR EACH SYSTEM TYPE."

Turn to Subsection 1:250 for a description of staff requirements and scheduling for this strategy and to 1:340 for further description.

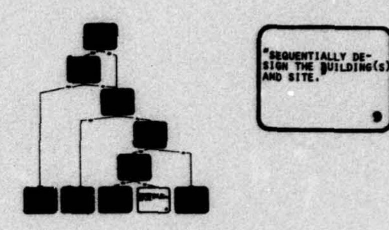


BOX NO. 8 - "DEVELOP A 'FOOTPRINT' FOR THE BUILDING(S)".

Turn to Subsection 1:260 for a description of staff requirements and scheduling for this strategy, and to 1:350 for further description.

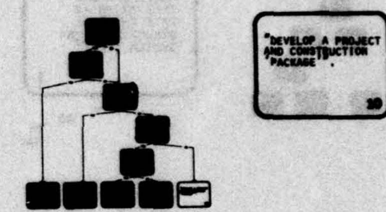
BOX NO. 9 - "SEQUENTIALLY DESIGN THE BUILDING(S) AND SITE".

Turn to Subsection 1:270 for a description of staff requirements and scheduling for this strategy, and to 1:360 for further description.



BOX NO. 10 - "DEVELOP A PROJECT DESIGN AND CONSTRUCTION 'PACKAGE' "

Turn to Subsection 1:280 for a description of staff requirements and scheduling for this strategy, and to 1:370 for further description.



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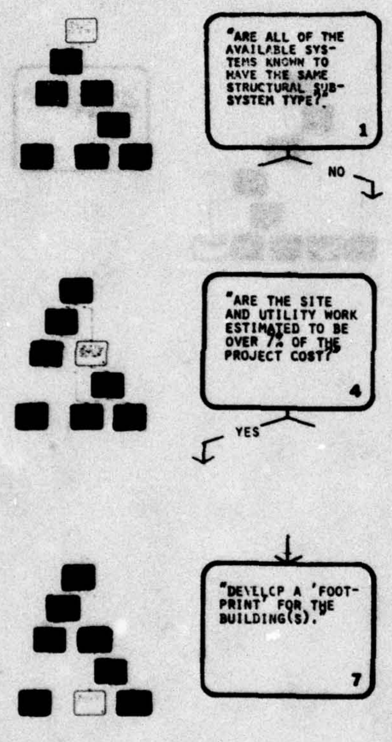
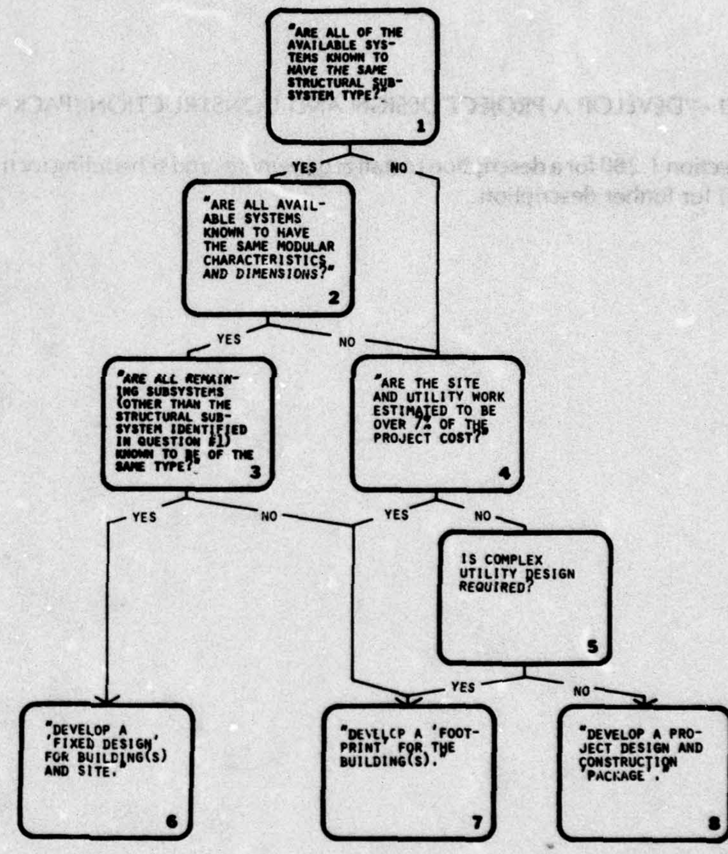
1:243 STRATEGY SELECTION: STORAGE

Below is a networkof questions to be used in determining which strategy will be best suited for use on the project. Proceed through the network as illustrated in the marginal example.





QUESTION NO. 1 - "ARE ALL[1] OF THE AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME STRUCTURAL SUBSYSTEM TYPE?"

The available systems for a project may be either those identified by the CERL data bank (see subsection 2:431) or others which have been identified locally by the district. Those identified in the CERL data bank list the type of structural subsystem for each system as either volumetric, panel or frame, and include information on modular characteristics and dimensions. Define locally identified subsystems by the criteria below:

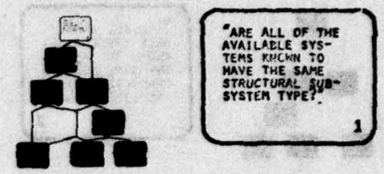
Volumetric: A structural subsystem type composed of integrated wall, ceiling and/or floor that encloses a volume. Wood or metal stud and joist construction are used in many volumetric type sturctural systems.

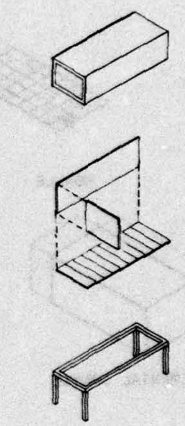
Panel: A structural subsystem type which utilizes bearing and spanning panels to form spaces. (Wood or metal and joist construction to which skins have been applied to both faces, which are specifically intended to be erected as bearing and spanning panels—such as plywood folded plates—are considered to be a panel type structural subsystem.)

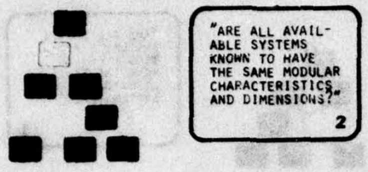
Frame: A structural subsystem type which utilizes a skeleton of columns, joists and/or beams, to support floor and wall panels to create space.

It must be possible to develop at least one structural-framing diagram (such as illustrated in the margin) which can be readily produced by all available systems in order to answer this question "Yes."

If the answer to question No. 1 is:
Yes. . . go to question No. 2
No . . . go to question No. 4







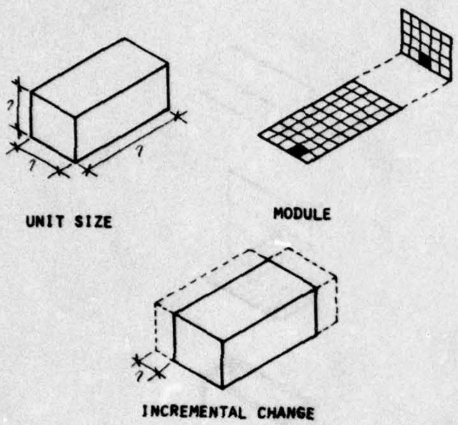
QUESTION NO. 2 - "ARE ALL AVAILABLE SYSTEMS KNOWN TO HAVE THE SAME MODULAR CHARACTERISTICS AND DIMENSIONS?"

This information is available from the CERL data bank. For locally identified systems, establish:

Standard unit size, *i.e.*, length, width and height.

Standard or most used:

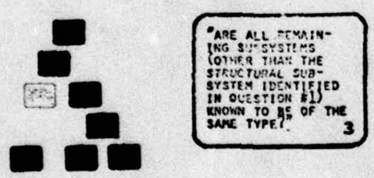
modular size
panel size
bay size
floor to floor height



Determine what cantilevers are permitted.

Compare this information for similarity between the available systems. Where it is known to be possible to develop at least one layout which can be readily accommodated by all available systems, answer this question "Yes". Where significant variations are found or adequate information is not available, answer this question "No".

If the answer to question No. 2 is:
Yes. . . go to question No. 3
No . . . go to question No. 4

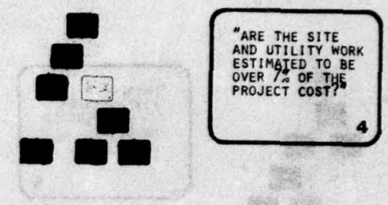


QUESTION NO. 3 - "ARE ALL REMAINING SUBSYSTEMS (OTHER THAN THE STRUCTURAL SYBSYSTEM IDENTIFIED IN QUESTION NO. 1) KNOWN TO BE OF THE SAME TYPE?"

Do each of the systems provided a complete set of comparable subsystems? For example, if interior offices are required in the storage facility, is it known that each of the systems provide a similar type of partition, office lighting and finished ceiling? Is the HVAC of each system of a similar type?

If the answer to question No. 3 is:
Yes. . . go to box No. 6
No . . . go to box No. 7

QUESTION NO. 4 — "IS THE SITE AND UTILITY WORK ESTIMATED TO BE OVER 7% OF THE PROJECT COST?"



Beyond this percentage the following conditions often occur:

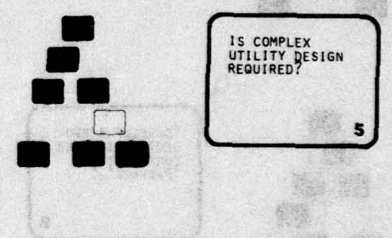
The site planning demands a high degree of design control, making it difficult to specify using performance requirements.

The building system contractor will not have the experience or resources necessary to adequately design the sitework, without incurring additional professional fees.

If the answer to question No. 4 is:

Yes. . . go to box No. 7
No . . . go to question No. 5

QUESTION NO. 5 - "IS A COMPLEX UTILITY DESIGN REQUIRED?"

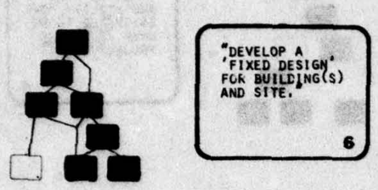


Where utilities must be included *in the project to service existing or future facilities*, answer this question "Yes", and answer "Yes" where site utility design is complicated by utility vaults, excessive site contour changes or existing site drainage problems. Such conditions are most effectively conventionally designed by Corps consultants. Where these conditions do not exist answer this question "No". Design requirements for less complicated utility layouts can readily be specified in Performance/Prescriptive terms.

If the answer to question No. 5 is:

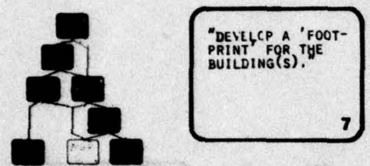
Yes. . . go to box No. 7
No . . . go to box No. 8

Possible Strategies



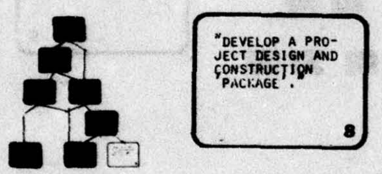
BOX NO. 6 - "DEVELOP A 'FIXED DESIGN' FOR BUILDING(s) AND SITE".

Turn to Subsection 1:250 for a description of staff requirements and scheduling for this strategy, and to 1:340 for further description.



BQX NO. 7 — "DEVELOP A 'FOOTPRINT' FOR THE BUILDING(s).

Turn to Subsection 1:260 for a description of staff requirements and scheduling for this strategy, and to 1:350 for further description.



BOX NO. 8 - "DEVELOP A PROJECT DESIGN AND CONSTRUCTION 'PACKAGE' ".

Turn to Subsection 1:280 for a description of staff requirements and scheduling of this strategy, and to 1:370 for further description.

SECTION FIVE

STRATEGY: FIXED DESIGN

TABLE OF CONTENTS

1:250 STRATEGY: FIXED DESIGN

This section is continued from:

Housing	Subsection 1:241, Box 8
Administration/Classroom	Subsection 1:242, Box 6
Storage	Subsection 1:243, Box 6

1:251 GENERAL DESCRIPTION

The answers to the previous questions indicate that the next appropriate step is to develop a "Fixed Design". This will involve:

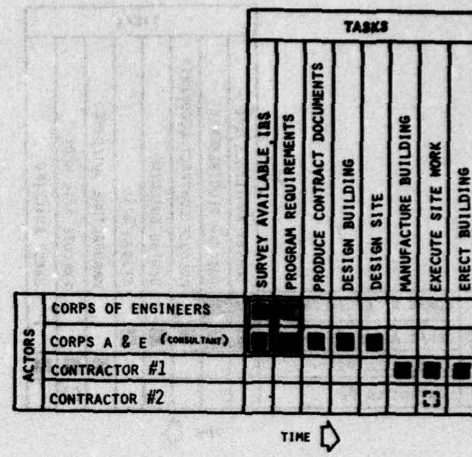
1. Programming the project, obtaining specific information on available building systems, and determining which contractors are able to aggregate and bid the available, precoordinated building subsystems.

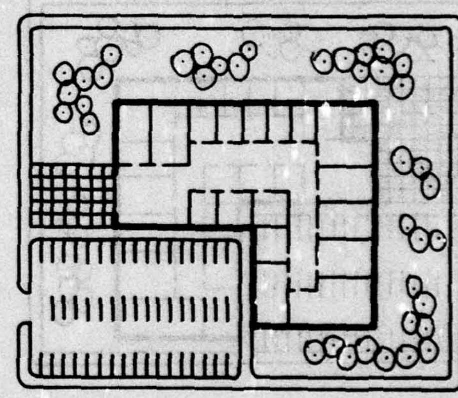
2. Designing the site and site utilities in the traditional way. Designing the building(s), based on the parameters or rules of the building system(s), to a completion corresponding to concept design drawings as described in ER 1110-345-710.

3. Defining the building system and subsystems by using a combination of performance and prescriptive specifications, so that the bidders can respond, employing their own system to maximum advantage.

4. Reviewing the successful bidder's details and hardware. Monitoring the production and erection of his system, and his execution of the site utilities work to see that contract requirements are met.

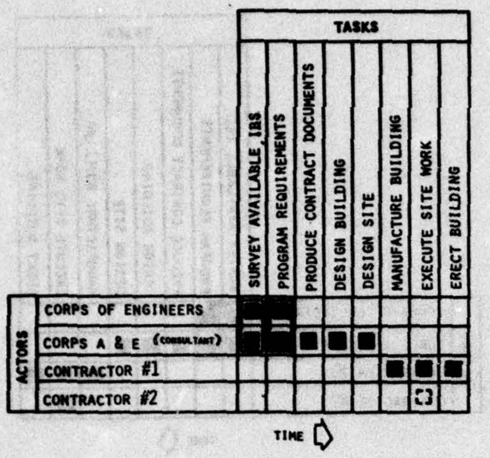
These procedures will provide control over building design while encouraging maximum acceptable industry response. Existing, precoordinated subsystems will be able to respond without being unduly penalized by having to conform to preconceived details and materials. This strategy will also provide design control over site work, utilities, traffic, parking, and planting without restricting optimum use of the bidder's system.

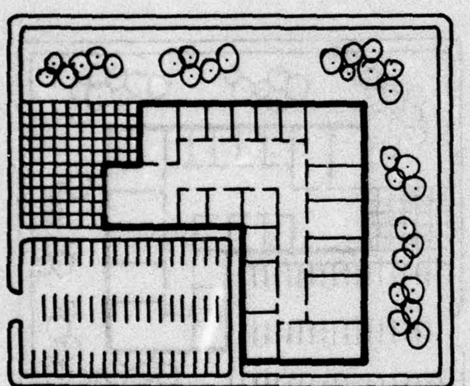




Programming

1:25
Fixed Design
01





1:252 STRATEGY: FIXED DESIGN VARIATIONS

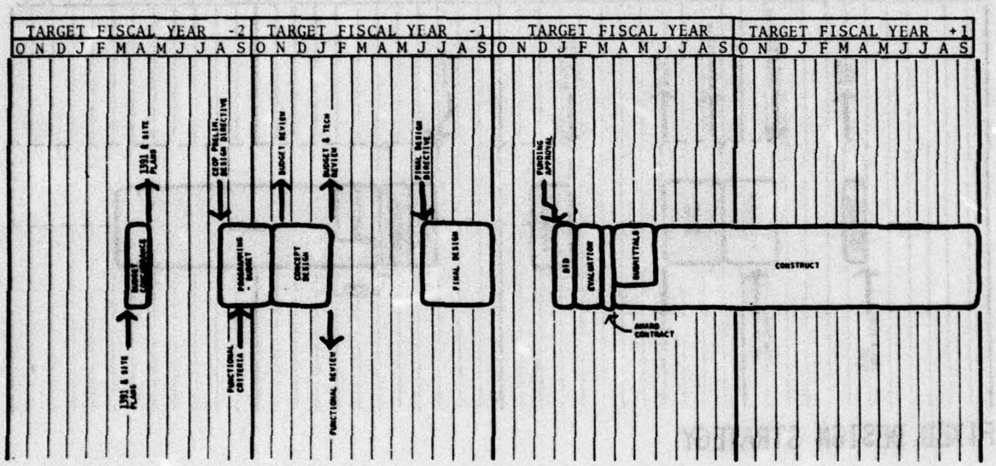
The procedure for accomplishing this is the same as developing a fixed design for a single available system, except that data is collected for each type of available system identified for this project, e. g., one for panel and one for frame, or one for the 4′ module and one for the 5′ module, etc. The principal effect of this will be evident in **Design and Documentation** coverage of "Characteristics of Available Building Systems" (Subsection 1:346). Adjustments will need to be made in the programming activities of staffing and scheduling (Subsection 1:253). Starting on the following page, proceed through the Fixed Design strategy, noting the variations referenced above.

02

1:253 STAFF REQUIREMENTS AND SCHEDULING[1]

Staffing for this strategy is affected by the change in sequencing and scope of activities. The same conditions that affect staffing also influence scheduling. In addition, the evaluation process that will occur following the receipt of bids, and the nature of the construction process involved, will influence the project schedule. Each of these is discussed below in the order in which it will occur, and is compared with conventional design and construction process.

The diagrams used to illustrate this strategy are based upon the complete diagram of the MCA cycle, shown in Section 1:200. For the purposes of this guide a simplified diagram of this process is presented below. It represents only those activities on the District level and their relationship to the Installation, Division, and OCE levels.



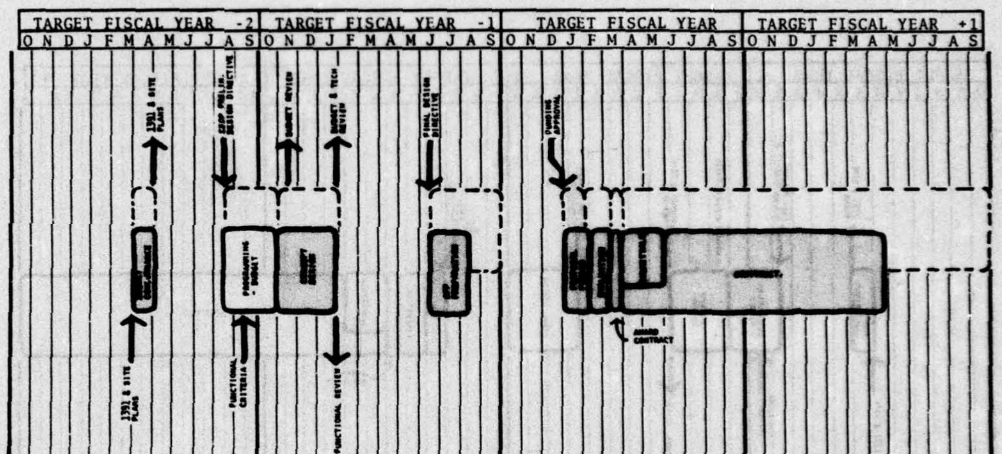
FIXED DESIGN STRATEGY

The diagrams which follow include the traditional design and construction process shown dotted for reference purposes.

[1] The rest of this section identifies staffing and scheduling arrangements as they necessarily differ from the conventional practice. For other aspects of this strategy see consecutive chapters, e.g., for Design and Documentation of fixed design strategy see 1:340

Product Information

For the Fixed Design Strategy, additional staff time will be required for discussions with industry, since detailed information on available systems and subsystems must be obtained to complete design and documentation, and since no "Sweet's Catalog" exists for building systems. Listings of manufacturers and the compatabilities among them are available from other sources. The additional time needed to collect and review such data is dependent upon the experience which the personnel have with these sources. It is therefore desirable to assign personnel who are familiar with IBS, and the available building subsystems for this task whenever possible. Schedule this collecting of information to run concurrently with other programming tasks.



FIXED DESIGN STRATEGY

Bidders

Whenever subsystems such as those which were provided by separate contractors in the E.F.L.-sponsored projects[1] are being considered, it will be necessary to located general contractors to bid, assemble, and coordinate these subsystems as a complete system. This will require a working knowledge of the systems and identification of potential contractors who are capable and willing to prepare a proposal on this basis. Schedule time to solicit the interest of such contractors during Programming and through Design and Documentation.

04

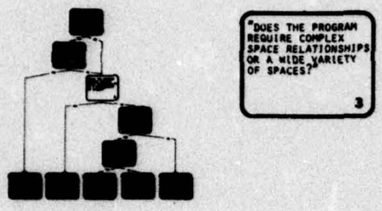
[1]See bibliography in 2:412

Design and Documentation

Reduce the scheduled design and documentation time by 10-15%, since drawings defining systems work need be carried only as far as *concept design* in the usual sense. The systems work will account for 40-70% of the project cost and a major proportion of the buildings design work. Many construction details normally included in bid documents will now be handled through shop drawings and similar submittals.

Drawing time can be reduced through modular and schematic design techniques. Design and documentation of the site utilities and *out-of-system work remain conventional*. Building contract drawings must be developed on a modular basis. System construction need be defined only to the extent found in traditional concept design drawings. Therefore, personnel to prepare working drawings will be required for a shorter period of time. Use personnel familiar with modular and system presentation techniques to execute this work.

Technical review during design and documentation can be comparably reduced, although an equal expenditure of time will be necessary during the evaluation of proposals. (Ref. Section 1:420).



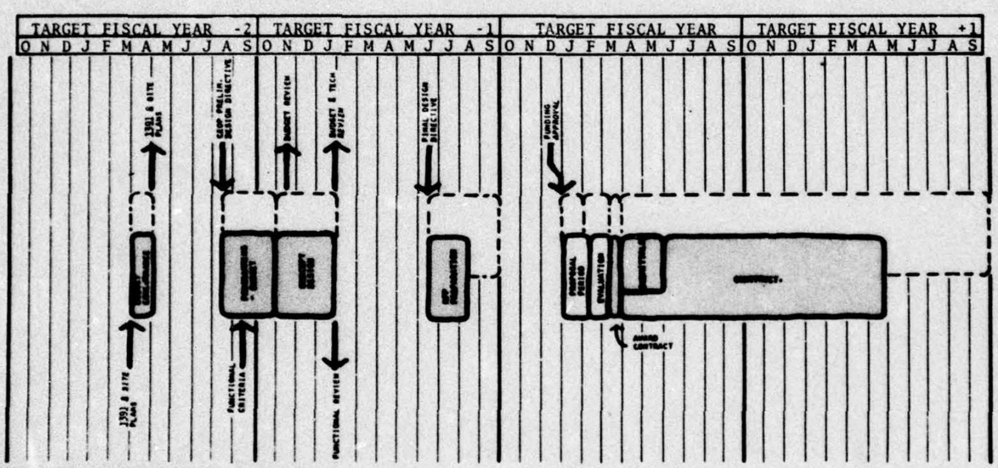
When building systems vary, *i.e.*, where question No. 3, Subsection 1:242 was answered "Yes," a separate design and contract drawings must be developed for each type of available system. For example, this may involve redrawing a design based upon both a 4-foot and 5-foot planning module, or developing a design for a panel and a frame system based on the same project requirements, etc. The time allotted to design and documentation will be reduced, from that normally scheduled for conventional design and construction, by 5-10%. The amount of reduction depends on the staff available, the size and complexity of the project and the number of fixed designs required. (Ref. Subsection 1:346)

When feasible, it is recommended that a team be used for each fixed design required. In essence, this will "Fast-track" the design phase.

Proposal

If it is decided to use procedures other than formal advertising, the period allowed for the industry to prepare a response must be modified. Since this guide assumes that the user is familiar with formal advertising procedures, the remarks in the remainder of this section are oriented toward the use of one-step, two-step and negotiations.

The time required for a bidder to prepare his proposal should be extended beyond that required for conventional bidding. Whereas a conventional bid only requires a cost analysis; to execute a design solution, a proposal request pursuant to either one-step competitive negotiation or two-step formal advertising requires both a design solution, or at least a choice of design solutions, and a cost analysis to execute that design solution. If, for example, 4 weeks is normally sufficient for a conventional bid period then at least 8 weeks should be allowed where various design solutions (and "or equal") are given in the RFTP or RFP. This extra time is required by the proposer to coordinate the various subsystems and ensure that there are no unsolved interface problems between the subsystems. If only performance criteria are given, and no proprietory solutions accompany the criteria, perhaps 10 weeks is needed. A pre-proposal conference midway into the bid period with the proposers minimizes problems and should eliminate the need to have a longer bid period.



FIXED DESIGN STRATEGY

Evaluation

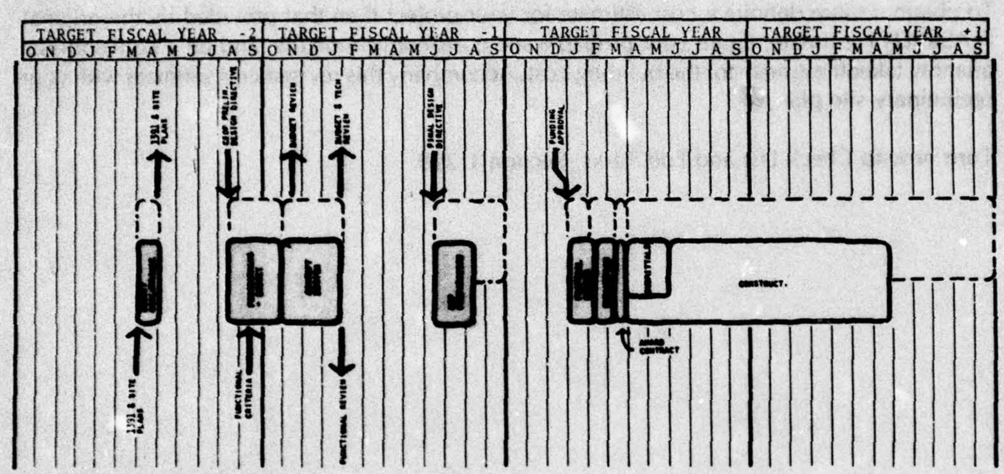
Schedule two or three weeks for evaluation of a project which has been allotted six weeks for proposal preparation. Review this part of the schedule at the completion of 85% of the design and documentation stage, to allow for any changes generated by project requirements. Utilize personnel capable of evaluating the proposals upon the basis of the program requirements and performance criteria rather than upon preconceived solutions. In this strategy, subsystem design is an integral part of the subsystems which are aggregated by the contractors. Evaluation of these subsystem designs must include checking similar to that normally done during working drawing and technical reviews. This checking is traditionally performed during the concept and final design periods, but in the fixed design strategy, must be performed during the evaluation period.

Submittals

Time for handling submittals will be greater than that required with conventional construction. Total additional time will be approximately equal to the time saved during design and documentation. Schedule time to review interface drawings, certification, system or subsystem mock-ups and calculations.

Factory Inspection

It is not anticipated that factory inspection will be required for this strategy. The majority of the systems suitable for this strategy are composed of field erected components, which allow for adequate field inspection. However, should the known available systems include volumetric units, panels with enclosed utilities, or closed utility cores, factory inspection should be scheduled; such factory inspection must occur prior to the actual field erection of the subsystem or major components, and parallel with other on-site construction.



FIXED DESIGN STRATEGY

CERL - FHM
Box 4005
Champaign, IL 61820
Telephone AC 217 352-6511

Construction Time

Actual construction time should be reduced. The contractor will be assembling precoordinated products with standardized interfaces will eliminate much handcrafting otherwise necessary for conventional construction. In addition, fabrication of components into subsystems has been done under factory-controlled conditions and can be field-erected as larger components of the total building.

Budget

To obtain a more definitive cost estimate for your project than that provided by the original FEASIBILITY estimate, figure your probable site costs conventionally, and do a conventional quantity takeoff estimate for the building cost. Accompany this revised cost estimate with your preliminary site plan. ■

Turn now to Check List and End Tasks, Section 1:290.

SECTION SIX

STRATEGY: FOOTPRINT

TABLE OF CONTENTS

1:260 STRATEGY: FOOTPRINT

This section is continued from:

Housing	Subsection 1:241, Box 9
Administration/Training	Subsection 1:242, Box 8
Storage	Subsection 1:243, Box 7

1:261 GENERAL DESCRIPTION

The answers to the previous questions indicate that the next appropriate step is to develop building "footprint" limits in which the successful contractor can erect his system. This will involve:

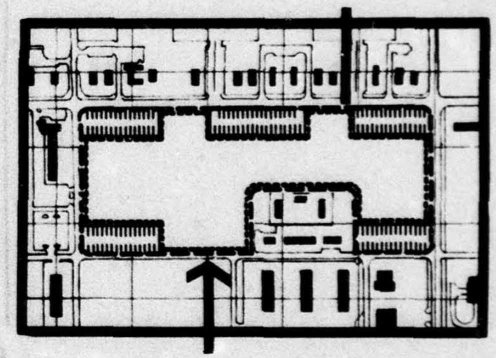
1. Programming the project and obtaining specific information on available building systems.
2. Designing the site and site utilities to provide a flexible, open plot in which to situate any one of the potential building systems with optimum utilization of its characteristics.
3. Defining the project using a combination of performance and prescriptive requirements to accommodate the known available systems, in order that bidders can respond with their own system used to its maximum advantage.
4. Reviewing the successful bidder's details and hardware; monitoring the production and erection of his system and his execution of site and utilities work (where applicable) to see that contract requirements are met.

These procedures will provide control over site and utility design beyond the building footprint, still allowing available building systems with dissimilar utility locations and plan configurations to actively compete in response to the program requirements. Site utilities, traffic, parking, and planting which is not integral with the building can be conventionally designed without restricting appropriate use of the proposer's systems.

ACTORS	SURVEY AVAILABLE IBS	PROGRAM REQUIREMENTS	PRODUCE CONTRACT DOCUMENTS	DESIGN BUILDING	DESIGN SITE	MANUFACTURE BUILDING	EXECUTE SITE WORK	ERECT BUILDING
CORPS OF ENGINEERS	■	■						
CORPS A & E (CONSULTANT)	■	■	■					
CONTRACTOR #1					■	■	■	■
CONTRACTOR #2							[ ]	

TASKS

TIME



AD-A034 131 CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAI--ETC F/G 13/13
AN INTERIM GUIDE TO INDUSTRIALIZED BUILDING SYSTEMS.(U)
JAN 76 S T LANFORD, T D CSIZMADIA, D BRYANT

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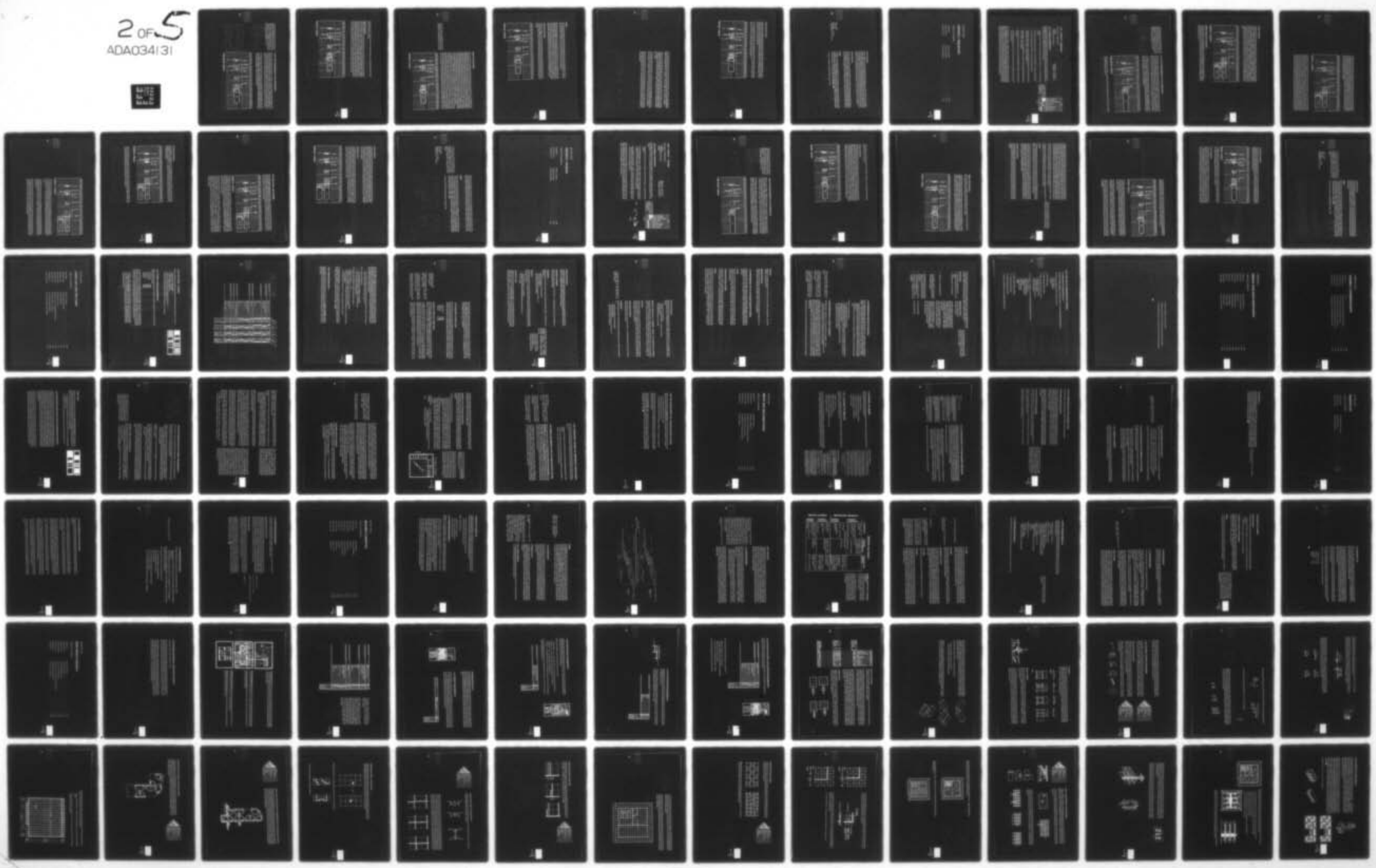

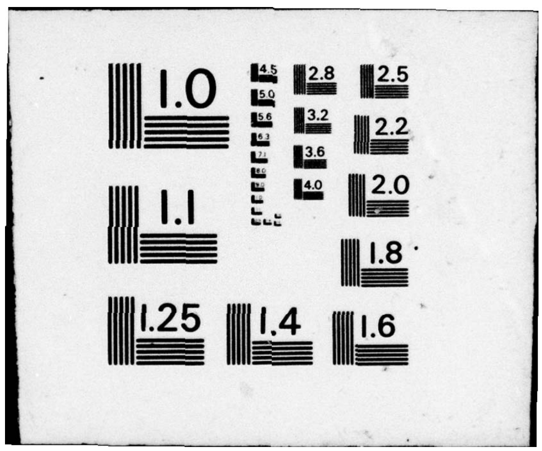
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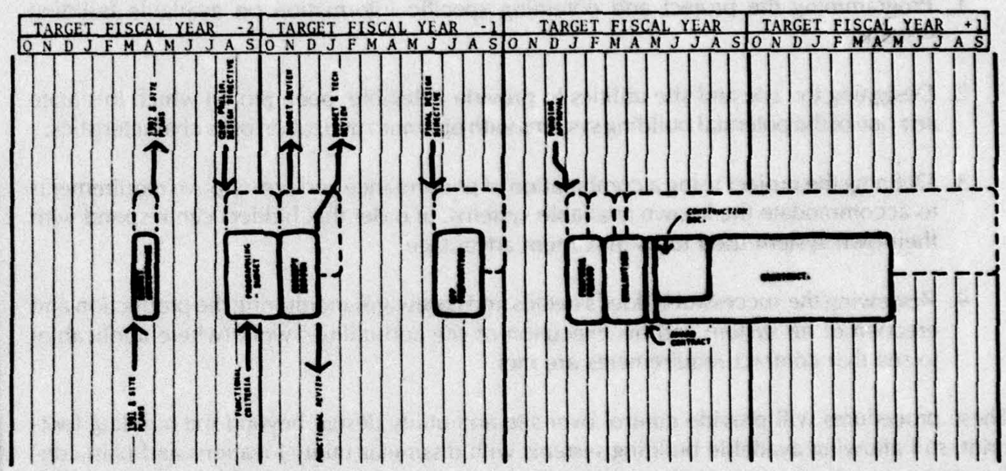
6.3

'The rest of this section identifies staffing and scheduling arrangements as they necessarily differ from the conventional practice. For other aspects of this strategy see consecutive chapters, *i.e.*, for Design and Documentation of footprint strategy see 1:350

1:262 STAFF REQUIREMENTS AND SCHEDULING'

Staffing for this strategy is affected by the change in sequencing and the scope of activities. The same conditions that affect staffing also influence scheduling. In addition, the evaluation process that will occur following the receipt of bids, and the nature of the construction process involved will influence the project schedule. Each of these is discussed below in the order in which it will occur, and is compared with the conventional design and construction process.

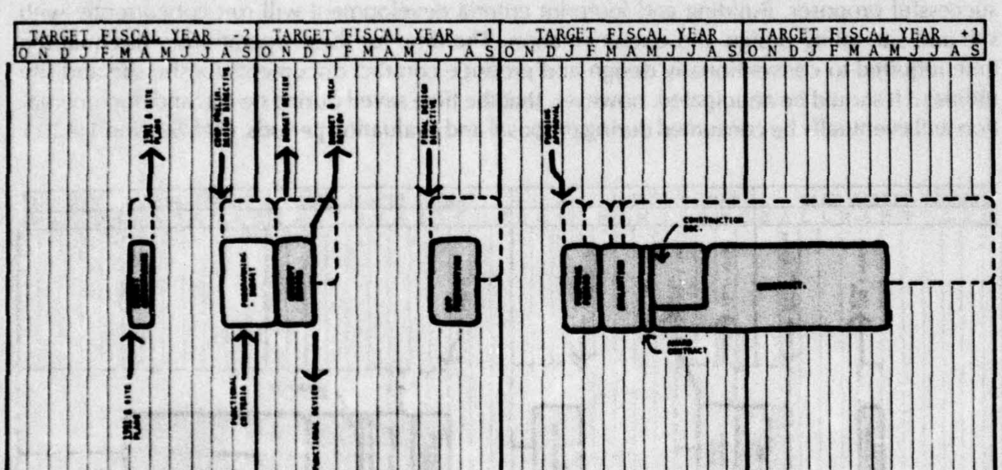
The diagrams used to illustrate this strategy are based upon the complete diagram of the MCA cycle, shown in Section 1:200. For the purposes of this guide a simplified diagram of this process is presented below. If represents only those activities on the District level and their relationship to the Installation, Division, and OCE levels.



FIXED DESIGN STRATEGY

The diagrams which follow include the traditional design and construction process shown dotted for reference purposes.

Product Information
Additional staff time will be required for discussions with industry, which in this case represents system manufacturers and contractors rather than conventional building material suppliers. Since no "Sweet's Catalog" exists for building systems, detailed information on available systems, both the hardware and the rules for putting them together, must be obtained to complete design and documentation. Schedule time to obtain this information, the amount of time scheduled being dependent upon the experience of those collecting the data on building systems, the amount of current information on hand, and the number of systems involved. Schedule this collecting of information to run concurrently with other programming tasks.



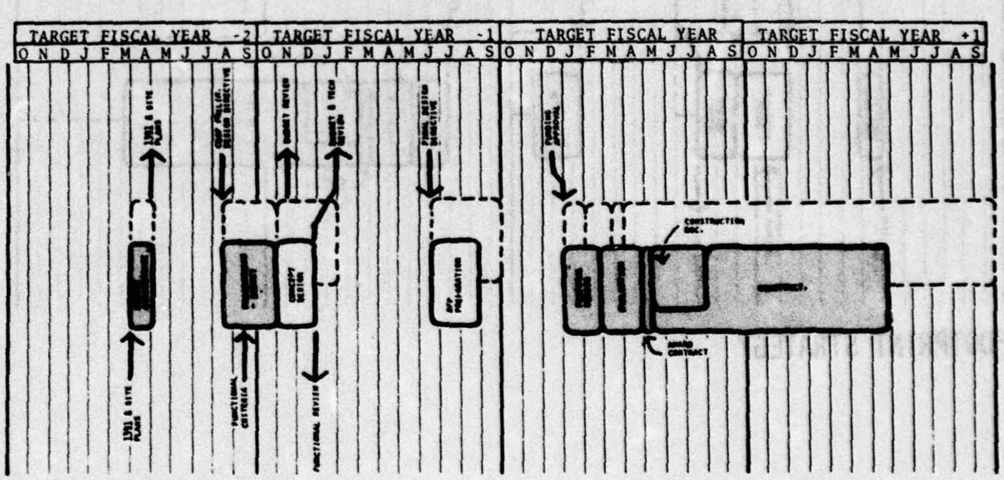
FOOTPRINT STRATEGY

Design and Documentation

The time normally scheduled for traditional design and documentation (concept design and RFP preparation) will be substantially reduced under this strategy, as a result of shifting actual building design from the design and documentation phase to the proposal period. Schedule design and documentation time to be equivalent to the total elapsed time normally allotted to conventional site and utility design and documentation. In lieu of the design normally done during this phase, illustrated and written criteria will need to be developed in order to define for the proposers what the building must be and how it must function. The traditional design of site work and utilities, defining the footprint, must be developed to accommodate the range of known available building systems by personnel who are familiar with the available systems and with the development and use of performance requirements whenever possible.

The "footprint" must be defined to accommodate the maximum variety of systems which are anticipated to be feasible. Design of the actual hardware already exists as an integral part of the available building systems. Layout and detailing of the actual building will be done by the successful proposer. Building and footprint criteria development will run concurrently with site and site utility design and documentation. The time for these operations will equal the time required to conventionally design and produce contract documents for the site and site utilities.[1] It should be anticipated, however, that the time saved during design and documentation will eventually be consumed during proposal and evaluation periods. (Ref. Section 1:420.)

[1] This time may be extended if personnel experienced in the development and use of performance requirements are not available.



FOOTPRINT STRATEGY

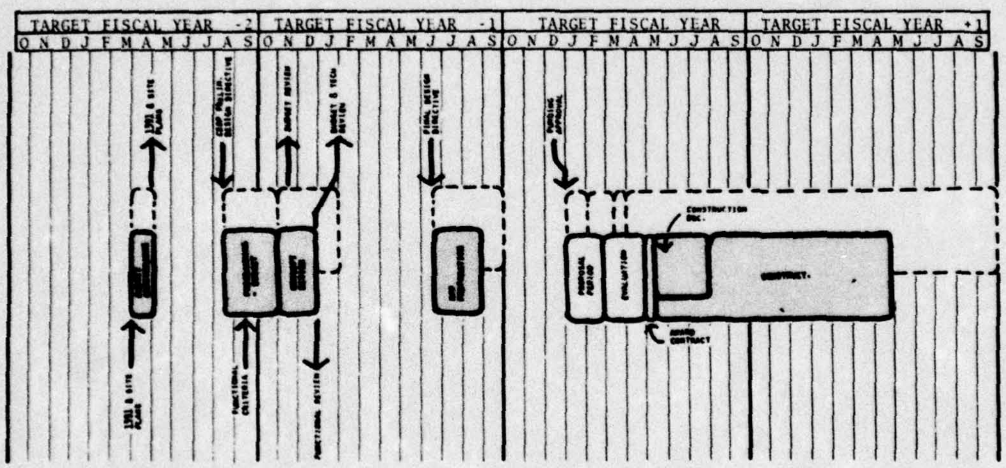
Reviews

The normal scheduling of both technical and additional reviews will be modified by this strategy. Schedule the using service review in two parts; the first at the completion of concept design for site and site utilities, and the second during evaluation of proposals.

Site and site utility design can be reviewed by the using service on a conventional basis. The proposal for the building will be developed upon the basis of criteria provided, rather than upon conventional plans and specifications. Therefore, the objective of the using service review of this part of the project will be to assure that the criteria complies with the program. The second review, during proposal evaluation, is actually part of the evaluation process, with the using service reviewing proposals for functional compliance with the RFP/RFTP criteria.

Proposal and Evaluation

Under this strategy, proposal and evaluation time must be extended beyond that required for conventional bidding. Some variation in the amount of time will occur between one- and two-step procurement, but this is due to the number of proposal steps rather than to this particular strategy.



FOOTPRINT STRATEGY

For one-step procurement, if four weeks normally suffice, then schedule an eight week proposal period. This amount of time is necessary to allow the proposer to analyze the RFP/RFTP, design the building within the "footprint," price the design, and compile his proposal.

Proposers will design the building(s), site work, and utilities within the "footprint" to accommodate their systems. During the evaluation period this design work will require checking for conformance with RFP/RFTP requirements similar to the conventional functional, technical, and design reviews. Utilize personnel capable of making this review on the basis of performance criteria.

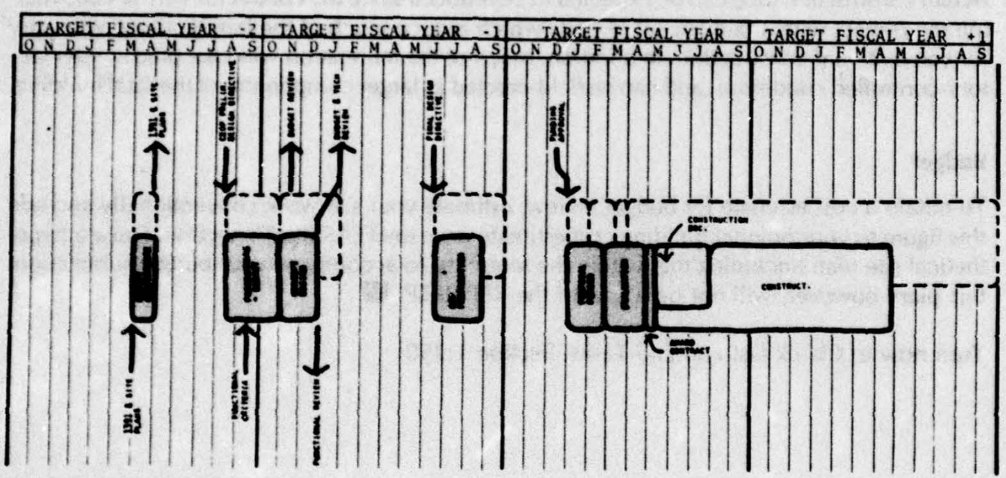
Schedule four weeks for evaluation of a project which has been allotted eight weeks for proposal development. Review this part of the schedule when approximately 85% of design and documentation is complete, to allow for any changes generated by project requirements.

When two-step procurement is being used, allow approximately the same amount of time for the proposal and first step evaluation as recommended above for one-step. For the second step, allow approximately thirty days, with half devoted to preparation, and half to evaluation of this second part.

Construction Documents

The construction documents required under this strategy include detailed drawings and materials lists from which the building will be constructed. They are prepared by the successful proposer and are best described as equivalent to a combination of working drawings and shop drawings in the conventional process.

The time required for preparation and checking these construction documents is greater than that conventionally required for shop drawings. Allow an amount of time approximately equal to the time saved during design and documentation.



FOOTPRINT STRATEGY

Factory Inspection

Factory inspection should be scheduled for this strategy, to commence early in the construction period, usually concurrent with the early site and foundation work. Factory inspection will be in lieu of much inspection normally performed in the field, but will not totally eliminate it. The time scheduled for factory inspection must be reviewed immediately upon award of contract, to establish more accurately the amount of factory inspection which will be required, since duration will be dependent upon the characteristics of the building system employed.

Construction Time

Actual construction time can be expected to be reduced since the contractor will be constructing the project with a familiar set of parts which reduce much of the handcrafting necessary for conventional construction. In addition, much of the fabrication will take place under factory-controlled conditions, and can be field-erected as larger components of the total building.

Budget

To obtain a cost estimate for budget review, estimate your site work conventionally and add this figure to your original building cost estimate from the FEASIBILITY section. Draw a hypothetical site plan (including that within the *footprint*) to accompany your budget submission; this plan, however, will *not* be a part of the RFP/RFTP.

Turn now to Check List and End Tasks, Section 1:290

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SECTION SEVEN

STRATEGY: SEQUENTIAL

TABLE OF CONTENTS

1:270 STRATEGY: SEQUENTIAL

This section is continued from:

Housing — Subsection 1:241, Box 10
Administration-Classroom — Subsection 1:242, Box 9

1:271 GENERAL DESCRIPTION

The answers to the previous questions indicate that a "Sequential" strategy should be used, *i.e.*, the building system is selected first, after which the site is designed, providing maximum accommodation for the selected system. This will involve:

1. Programming the project and obtaining specific information on available building systems.

2. Defining the building requirements in order that bidders can most readily respond.

3. Issuing the building system RFP/RFTP, and reviewing the proposals.

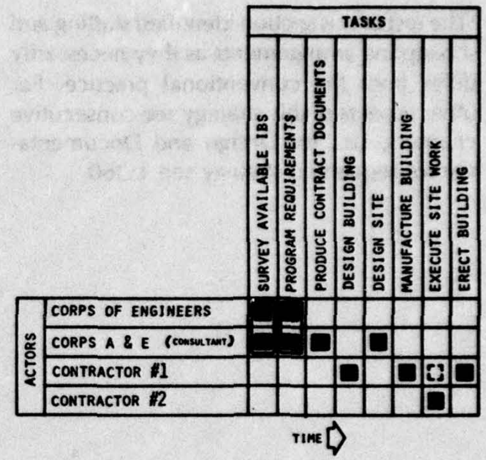
4. Awarding a contract to the successful system bidder, to prepare construction documents (while steps 5 and 6 below are being accomplished).

5. Designing the site work and site utilities, using the planning guidelines generated by the successful system proposer.

6. Bidding the site and utilities work, and awarding the building and site work construction contract(s).

7. Monitoring the building and site work contract(s) to assure conformance with the contract requirements.

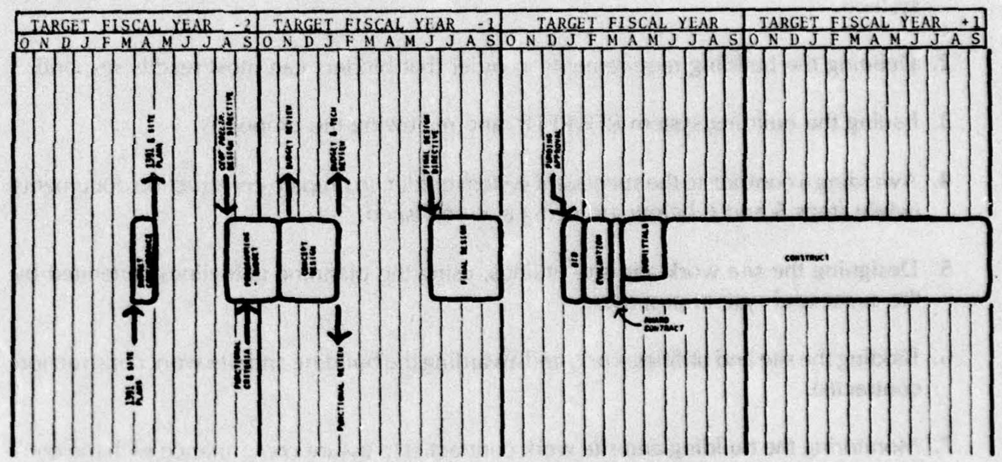
These procedures will allow available building systems with dissimilar utility locations and plan configurations to actively compete in response to the program requirements. The building design submitted by the successful proposer can be integrated with the site utilities, traffic, parking, and planting, which will be designed conventionally under this strategy. Maximum control over the location of the buildings, as provided by this strategy, assures control in developing a relationship between this project and other existing or future facilities.



1:272 STAFF REQUIREMENTS AND SCHEDULING[1]

Staffing for this strategy is affected by the change in sequencing and scope of activities. The same conditions that affect staffing also influence scheduling. In addition, the evaluation process that will occur following the receipt of bids, and the nature of the construction process involved will influence the project schedule. Each of these is discussed below in the order in which it will occur, and is compared with the conventional design and construction process.

The diagrams used to illustrate this strategy are based upon the complete diagram of the MCA cycle, shown in Section 1:200. For the purposes of this guide a simplified diagram of this process is presented below. It represents only those activities at the district level and their relationship to the Installation, Division, and OCE levels.



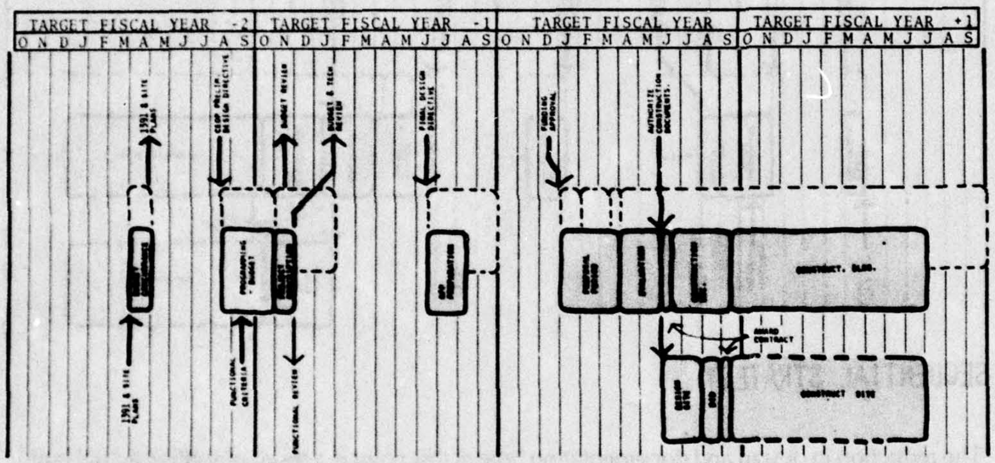
FIXED DESIGN STRATEGY

The diagrams which follow include the traditional design and construction process shown dotted for reference purposes.

[1]The rest of this section identified staffing and scheduling arrangements as they necessarily differ from the conventional practice. For other aspects of this strategy see consecutive chapters, *i.e.*, for Design and Documentation of sequential strategy see 1:360

Product Information

Additional staff time will be required for discussions with industry, which in this case represents system manufacturers and contractors rather than conventional building material suppliers. Since no "Sweet's Catalog" exists for building systems, detailed information on available systems, both the hardware and the rules for putting them together, must be obtained to complete design and documentation. Therefore, schedule time to obtain this information, the amount of time scheduled being dependent on the experience of those collecting the data on building systems, the amount of current information on hand, and the number of systems involved. Schedule this collection of information to run concurrently with other programming tasks.

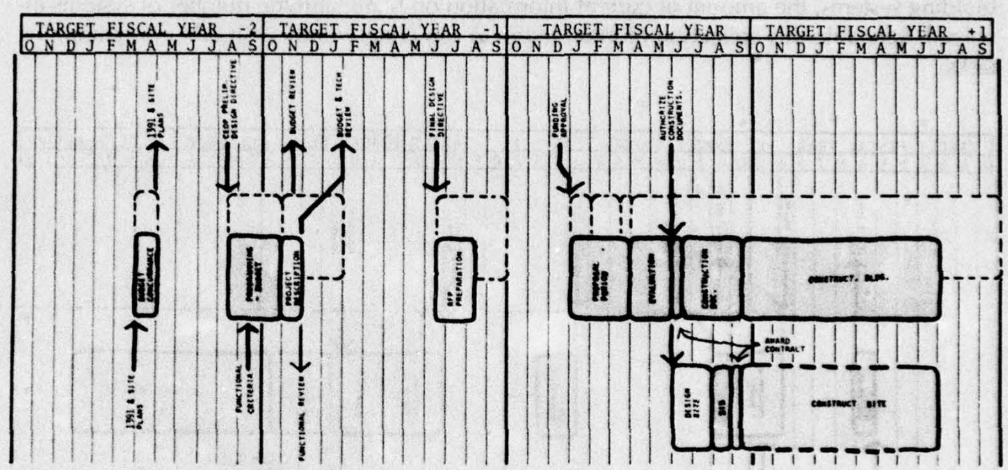


SEQUENTIAL STRATEGY

Building Design and Documentation

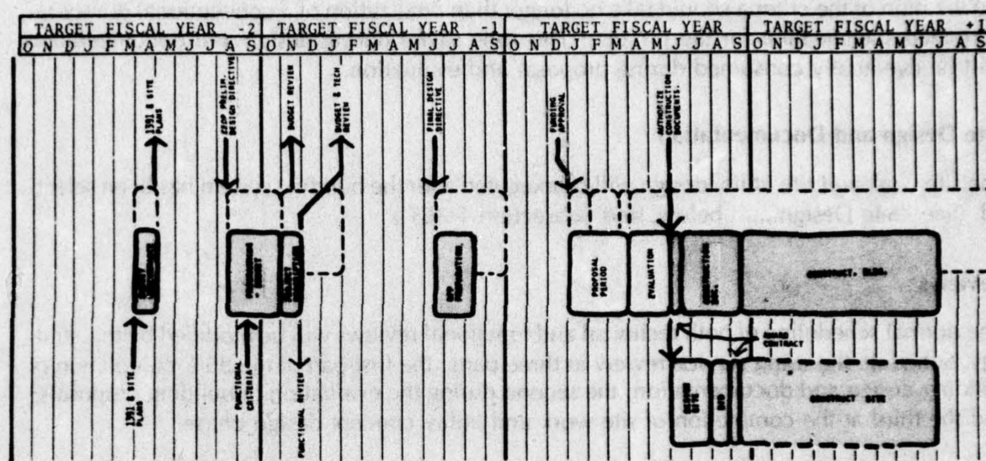
Under this strategy, design and documentation of the building site work will be separated, *i.e.*, "Project Description" and "RFP Preparation" will be separated from "Site Design." Schedule final design and documentation of the site work to occur after selection of building systems. (Ref. Subsection 1:361).

The time normally scheduled for design and documentation of the building will be substantially reduced under this strategy. Schedule design and documentation of the building equivalent to the total elapsed time normally allotted to concept design, plus completion of non-computerized specifications. For example, if it would normally require an elapsed time of two months to develop the conceptual design, and another month to complete non-computerized specifications for the final design, then schedule a total of three months for the design and documentation of the building under this strategy.



SEQUENTIAL STRATEGY

The reduction in design and documentation time at this point is a result of shifting actual building design from the design and documentation phase to the proposal period. In lieu of the design normally done during this phase, illustrated and written criteria will need to be developed in order to define for the proposers what the building must be and how it must function. The requirements must be developed to accommodate the range of known available building systems, by personnel who are familiar with the known available systems and with the development and use of performance requirements utilizing performance statements. (Ref. Subsection 1:302). Design of the actual hardware already exists as an integral part of the available building systems. Layout and detailing of the actual building will be done by the successful proposer.



SEQUENTIAL STRATEGY

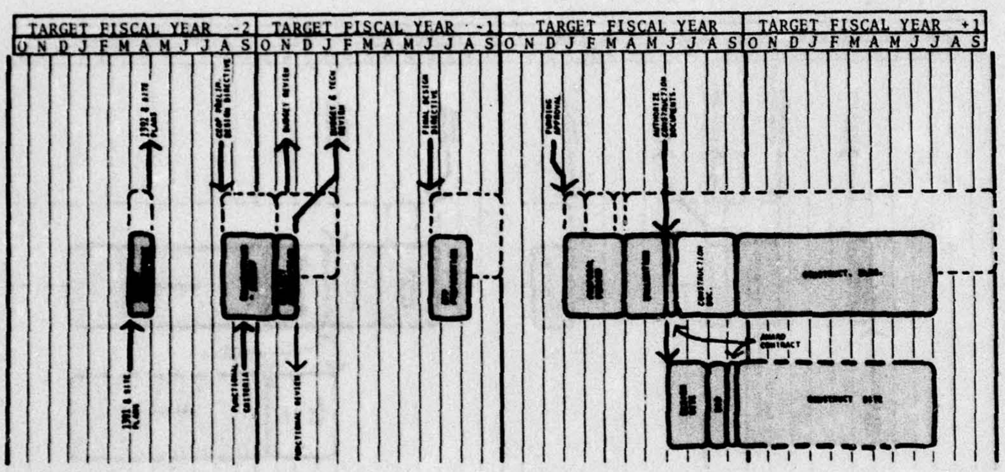
The design of the building(s) is done by the various proposers to accommodate their systems to maximum advantage. During the evaluation period this design work will require checking for conformance with the RFP/RFTP requirements similar to the conventional functional and technical reviews. Utilize personnel capable of making this review on the basis of performance criteria.

Schedule three weeks for evaluation of a building for which six weeks has been allotted for proposal development. Review this part of the schedule when approximately 85% of the building design and documentation is complete, to allow for any changes generated by project requirements.

When two-step procurement is being used, allow approximately the same amount of time for the building system proposal and first step evaluation as recommended above for one-step procurement. For the second step, allow approximately thirty days, with half devoted to the preparation and half to the evaluation of this second part.

Construction Documents

The construction documents include detailed drawings and materials lists from which the building will be constructed. They are prepared by the successful proposer and are best described as equivalent to a combination of working drawings and shop drawings in the conventional process.

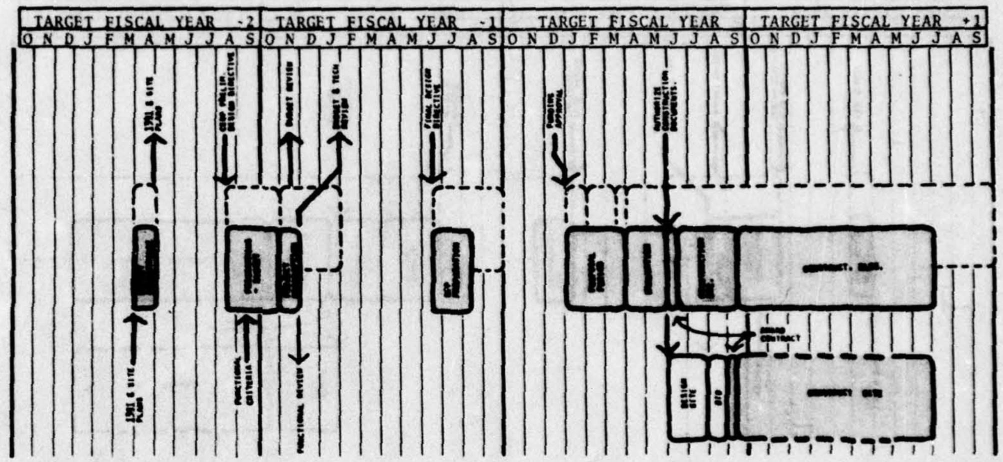


SEQUENTIAL STRATEGY

The time required for preparation and checking these construction documents is greater than that conventionally required for shop drawings. Allow an amount of time approximately equal to the time saved during design and documentation. (See above).

Site Design, Documentation and Bidding

Site work and utility design under this strategy can be done conventionally with the benefits of a full knowledge of the building system to be accommodated, and of any other requirements which must be provided to allow the system to be utilized most effectively on that specific site. Schedule time for these activities equivalent to the time which would be required to execute this work for a conventional project.



SEQUENTIAL STRATEGY

Schedule the usual amount of time for bidding of site and site utility work. This part of the project, being conventionally designed and executed, will not require additional bidding duration. Bidding of the work will be concurrent with the development and completion of the building systems construction documents. Any delay in designing and bidding the site work will result in an equivalent delay in the building system construction contract award and should, therefore, be avoided.

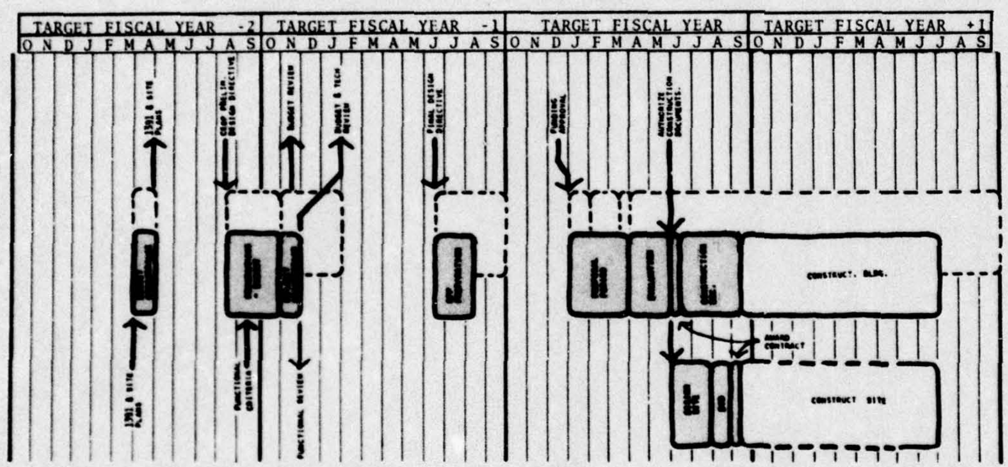
One way to minimize delays and inter-contractor disputes is to provide for construction of both building and site by a single general contractor. In this option the building subsystems are awarded to suppliers by either contracts or "letters of intent." If a contract is awarded the building subsystems are furnished to the general contractor as "government-furnished equipment" (GFE). If letters of intent are used the general contractor is authorized to buy the systems for the project at prices previously established between the government and the systems suppliers.

Factory Inspection

Factory inspection should be scheduled for this strategy, commencing early in the construction period (usually prior to or concurrent with the early site and foundation work). Factory inspection will be in lieu of much inspection normally performed in the field, but will not totally eliminate it. The time scheduled for factory inspection must be reviewed immediately upon award of the building contract. This will establish more accurately the amount of factory inspection which will be required since duration will be dependent upon the characteristics of the building system employed.

Construction Time

The building system construction contract will be awarded at the same time as the site work contract. Actual construction time for the building can be expected to be reduced, since the successful building system proposer will be constructing the project with a familiar set of parts which reduce much of the handcrafting necessary for conventional construction. In addition, much of the fabrication will take place under factory-controlled conditions, and can be field-erected as larger components of the total building.



SEQUENTIAL STRATEGY

Site work and site utility construction time can be expected to follow traditional patterns. This work can be scheduled to commence as soon as possible after the award of contract, but must be coordinated with the sequence of erection and completion of the building systems, particularly if site work progress may influence delivery, storage, or field-assembly of system work.

Budget

Revise your first cost estimate to provide a *figure for budget review: add the probable cost of* site work to the building cost estimate obtained in your FEASIBILITY study. Figure site work at 7.5% of building cost[1] unless you know overriding site conditions will require significant deviation from this figure—either upward or downward. Accompany this revised cost estimate with your preliminary site plan, which should be annotated, "To be adapted as required to accomodate *proposer's system.*" ■

Turn now to Check List and End Tasks, Section 1:290

[1]A site cost of 7.5% of the building costs is an average based on 93 systems projects reported by Building Systems Information Clearinghouse, along with 43 conventional projects reported in *Engineering News Record.*

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SECTION EIGHT

STRATEGY: PACKAGE

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1:280 STRATEGY: PACKAGE

This section is continued from:

Housing	Subsection 1:241, Box 11
Administration-Classroom	Subsection 1:242, Box 10
Storage	Subsection 1:243, Box 8

1:281 GENERAL DESCRIPTION

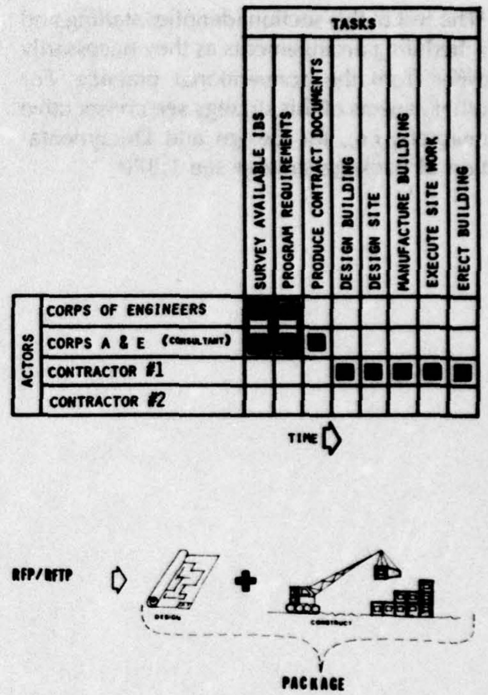
The answers to the previous questions indicate that a "package" strategy should be used, *i.e.*, the building(s) and the site are designed and provided by the successful proposer. This will involve:

1. Programming the project and obtaining specific information on available building systems.

2. Defining the project using a combination of performance and prescriptive requirements to accommodate the known available systems, in order that bidders can design the building(s) and site utilizing their system to its maximum advantage.

3. Reviewing the successful bidder's details and hardware; monitoring the production and erection of his system and his execution of site and utilities work (where applicable) to see that contract requirements are met.

These procedures will allow available building systems with dissimilar utility locations and plan configurations to actively compete in response to the program requirements. They will allow the proposer the widest latitude in which to develop the most appropriate use of his system, while still satisfying the user's requirements.



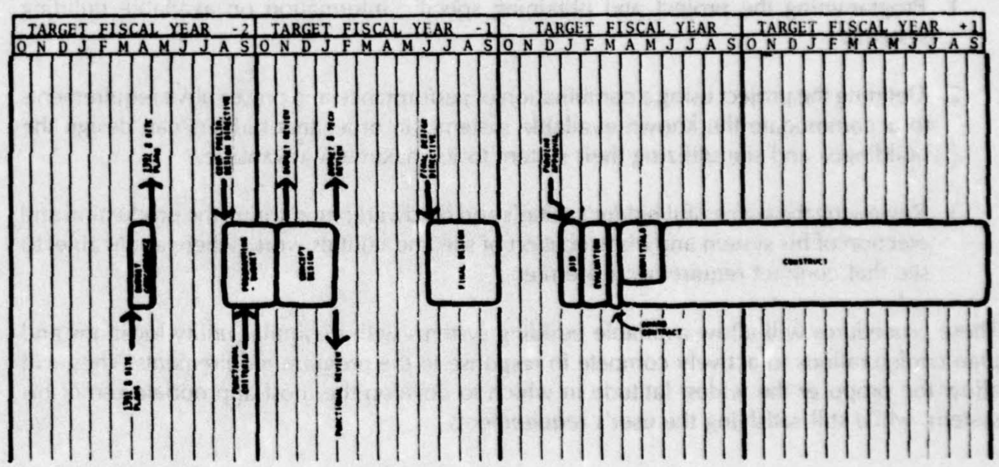
1:28
Package
01

[1] The rest of this section identifies staffing and scheduling arrangements as they necessarily differ from the conventional practice. For other aspects of this strategy see consecutive chapters, *i.e.*, for Design and Documentation of package strategy see 1:370

1:282 STAFF REQUIREMENTS AND SCHEDULING

Staffing for this strategy is affected by the change in sequencing and scope of activities. The same conditions that affect staffing also influence scheduling. In addition, the evaluation process that will occur following the receipt of bids, and the nature of the construction process involved will influence the project schedule. Each of these is discussed below in the order in which it will occur, and in comparison with a conventional design and construction process.

The diagrams used to illustrate this strategy are based upon the complete diagram of the MCA cycle, shown in the introduction. (Section 1:200.) For the purposes of this guide a simplified diagram of this process is presented below. It represents only those activities on the District level and their relationship to the Installation, Division, and OCE levels.

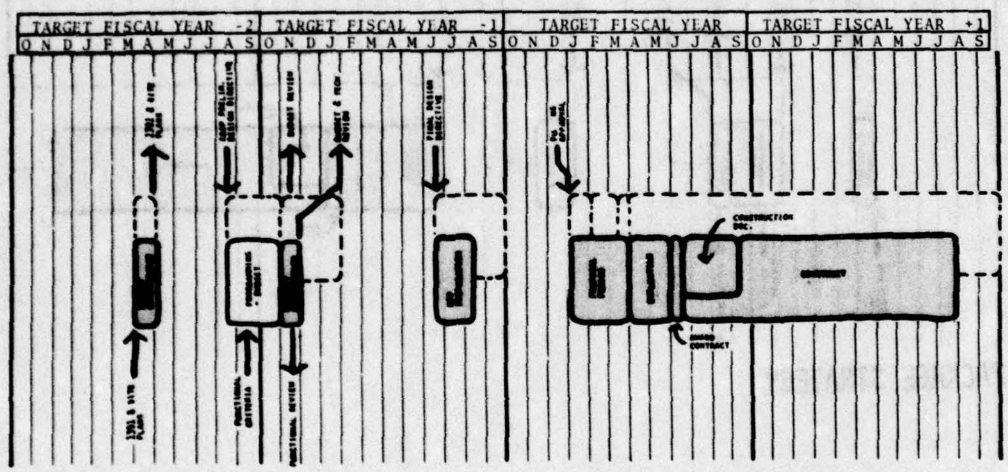


FIXED DESIGN STRATEGY

The diagrams which follow include the traditional design and construction process shown dotted for reference purposes.

Product Information

Additional staff time will be required for discussions with industry; industry in this case represents system manufacturers and contractors rather than conventional building materials suppliers. Since no "Sweet's Catalog" exists for building systems, detailed information on available systems, both the hardware and the rules for putting them together, must be obtained to complete design and documentation. Schedule time to obtain this information, the amount of time scheduled being dependent upon the experience of those collecting the data on building systems, the amount of current information on hand, and the number of systems involved. Schedule this collecting of information to run concurrently with other programming tasks.



PACKAGE STRATEGY

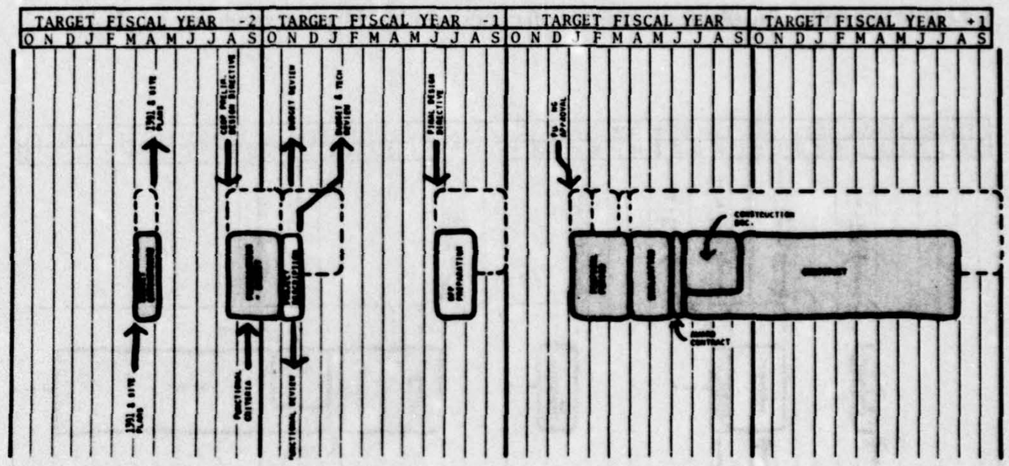
Programming

1:28
Package
03

Design and Documentation

The time normally scheduled for traditional design and documentation (project description, RFP preparation) will be substantially reduced under this strategy.

Schedule design and documentation time as equivalent to the total elapsed time normally allotted to conceptual design, plus completion of non-computerized specifications. For example, if it would normally require an elapsed time of two months to develop the conceptual design, and another month to complete specifications for the final design, then the design and documentation phase of this strategy need not exceed that same three months elapsed time.



PACKAGE STRATEGY

A reduction in design and documentation time from this stage on is a result of shifting actual building and site design from the design and documentation phase to the proposal period. In lieu of the design work normally done during this phase, illustrated and written criteria will be developed to define for the proposers what the building and site work must include, and how they must function. These criteria must be developed to accommodate the range of known available building systems, by personnel who are capable of developing and utilizing performance requirements and who are familiar with the available systems. (Ref. Subsection 1:371.) Layout and detailing of the actual building and site will be done by the successful proposer.

Development of the criteria described above need not exceed the time required for completion of a non-computerized specification for a conventional project.[1]

It should be anticipated, however, that the time saved during design and documentation will eventually be consumed during the proposal and evaluation periods.

Reviews

The normal scheduling of both technical and functional reviews will be modified by this strategy. Schedule the using service review in two parts; the first part on completion of 85% of the design and documentation phase, and the second during evaluation of proposals.

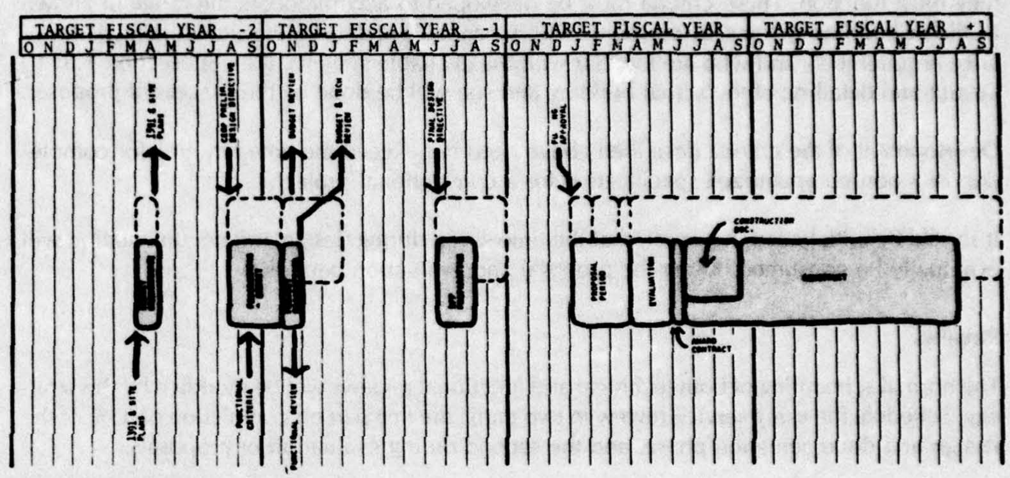
The proposal for the building and site work will be developed upon the basis of criteria provided, rather than upon conventional plans and specifications. Therefore, the objective of the initial using service review will be to assure that the criteria developed during design and documentation complies with the program. The second review, during proposal evaluation, is actually part of the evaluation process, with the using service reviewing the proposals for functional compliance with the RFP/RFTP criteria.

Proposal and Evaluation

Under this strategy, proposal and evaluation time must be extended beyond that required for conventional bidding. Some variation in the amount of time will occur between one- and two-step procurement, but this is due to the number of proposal steps rather than to this particular strategy.

[1]This time may be extended if the personnel experienced in the development and use of performance requirements are not available.

For one-step procurement, if four weeks normally suffice, then schedule an eight-week proposal period. This amount of time is necessary to allow the proposer to analyze the RFP/RFTP, design the building and the site, price the design, and compile his proposal.



PACKAGE STRATEGY

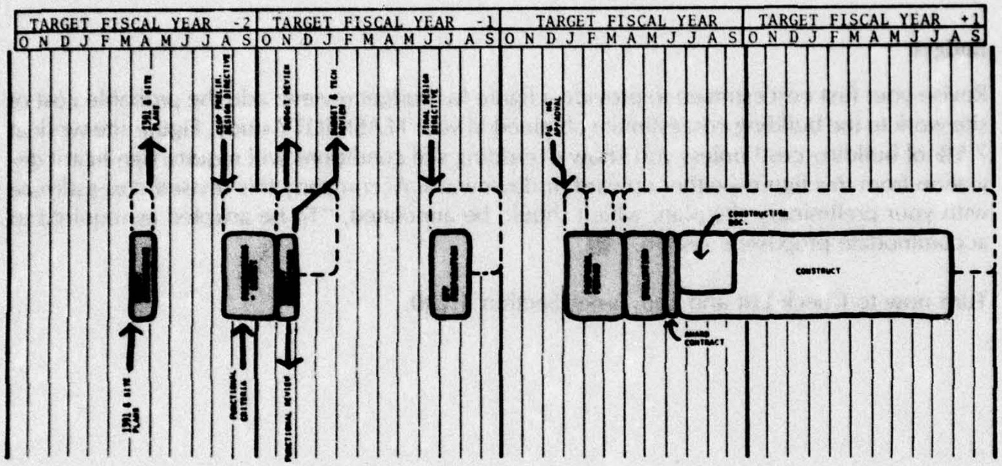
The design of the building(s) and site is done by the various proposers to accommodate their systems to maximum advantage, during the evaluation period. This design work will require checking for conformance with RFP/RFTP requirements similar to the conventional professional and technical reviews. Utilize personnel capable of making this review on the basis of performance criteria.

Schedule four weeks for evaluation of a project which has been allotted eight weeks for proposal development. Review this part of the schedule when approximately 85% of design and documentation is complete, to allow for any changes generated by project requirements.

When two-step procurement is being used, allow approximately the same amount of time for proposal and first step evaluation as recommended above for one-step. For the second step, allow approximately thirty days, with half devoted to preparation, and half to evaluation of this second part.

Construction Documents

The construction documents required under this strategy include detailed drawings and materials lists from which the building will be constructed. They are prepared by the successful proposer and are best described as equivalent to a combination of working drawings and shop drawings in the conventional process.



PACKAGE STRATEGY

The time required for preparing and checking these construction documents is greater than that conventionally required for shop drawings. Allow an amount of time approximately equal to the time saved during design and documentation. (See above).

Factory Inspection

Factory inspection should be scheduled for this strategy, to commence early in the construction period, usually concurrent with the early site and foundation work. Factory inspection will be in lieu of much inspection normally performed in the field, but will not totally eliminate it. The time scheduled for factory inspection must be reviewed immediately upon award of contract, to establish more accurately the amount of factory inspection which will be required since duration will be dependent upon the characteristics of the building system employed.

Construction Time

Actual construction time can be expected to be reduced, since the successful contractor will be constructing the project with a familiar set of parts which reduce much of the handcrafting necessary for conventional construction. In addition, much of the fabrication will take place under factory controlled conditions, and can be field-erected as larger components of the total building.

Budget

Revise your first cost estimate to provide a figure for budget review: add the probable cost of site work to the building cost estimate obtained in your FEASIBILITY study. Figure site work at 7.5% of building cost[1] unless you know overriding site conditions will require significant deviation from this figure—either upward or downward. Accompany this revised cost estimate with your preliminary site plan, which should be annotated, "To be adapted as required to accommodate proposer's system." ■

Turn now to Check List and End Tasks, Section 1:290.

[1]A site cost of 7.5% of the building costs is an average based on 93 systems projects reported by Building Systems Information Clearinghouse, along with 43 conventional projects reported in *Engineering News Record*.

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SECTION NINE

CHECK LIST AND END TASKS

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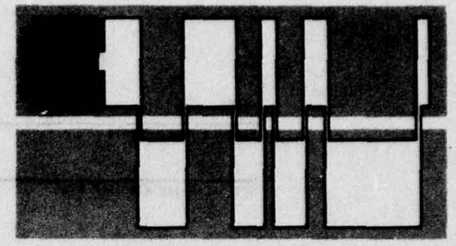


1:290 END TASKS — GENERAL

Before completing the *Programming* phase, the following end tasks should be carried out:

- prepare project design program;
- compile human needs data;
- compile building systems data;
- prepare a preliminary list of available building systems;
- send out preliminary notices to industry, and
- prepare and submit an *environmental impact statement,* if required.

1:291 PROJECT DESIGN REQUIREMENTS

Before preparing the *project design* requirements, the applicable sections from the following list should be reviewed:

Introduction	**1:300**
Fixed Design	**1:340**
Footprint	**1:350**
Sequential	**1:360**
Package	**1:370**

To systematically structure available project information and to present it in appropriate terms, structure it to conform with the matrix diagram, (following page). The matrix parallels the recommended format for bid documents. Depending on the strategy chosen, the diagram identifies which of the project requirements are best described in traditional prescriptive terms, a combination of prescriptive and performance terms, or in performance terms.

Example: If the *footprint strategy* is being used, the two items comprising **Context** and **Master Plan Considerations** have a dot located in the prescriptive column, because these are best described in prescriptive terms. **Site Planning Requirements,** however, have a dot in the prescriptive/performance column since they are best described in those terms.

		FIXED DESIGN				FOOTPRINT				PACKAGE				SEQUENTIAL			
		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
PROJECT REQUIREMENTS	CONTEXT	●				●					●			●			
	MASTER PLAN CONSIDERATIONS	●				●					●				◐		◐
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS	●					●					●					●
	CIRCULATION - PEOPLE, VEHICLES	●					●					●					●
	BUILDING ADJACENCY	●					●					●					●
	UTILITY AVAILABILITY	●					●					●					●
SITE SUBSYSTEMS REQUIREMENTS	GRADING	●				●					●						●
	PLANTING	●				●					●						●
	PAVING	●				●					●						●
	WATER	●				●					●						●
	SEWER	●				●					●						●
	ELECTRICAL	●				●					●						●
	COMMUNICATIONS	●				●					●						●
BUILDING PLANNING REQUIREMENTS	ADJACENCY OF FUNCTIONAL GROUPS	●						●				●				●	
	CONFIGURATION	●						●				●				●	
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●				●				●				●		
	VERTICAL + HORIZONTAL STRUCTURE		●					●				●				●	
	VERTICAL TRANSPORTATION		●					●				●				●	
	ROOF		●					●				●				●	
	EXTERIOR WALLS		●					●				●				●	
	INTERIOR SPACE DIVISION		●					●				●				●	
	HVAC		●				●				●				●		
	ELECTRICAL	●					●				●				●		
	PLUMBING	●					●				●				●		
	LIGHTING		●					●				●				●	
	COMMUNICATIONS	●					●				●				●		
FUNCTIONAL GROUP REQUIREMENTS	TASK PERFORMANCE CONSIDERATIONS							●				●				●	
	QUANTITY - ADJACENCY OF UNIT SPACES							●				●				●	
UNIT SPACE PLANNING REQUIREMENTS	SPATIAL							●				●				●	
	FUNCTIONAL DESCRIPTION							●				●				●	
UNIT SPACE SUBSYSTEMS REQUIREMENTS	FIXED EQUIPMENT						●				●				●		
	MOVABLE FURNISHINGS						●				●				●		
	PLUMBING						●				●				●		
	HVAC						●				●				●		
	LIGHTING							●				●				●	
	COMMUNICATIONS /POWER						●				●				●		

The matrix diagram should be used to minimize those items to be described in prescriptive terms. Frequently, available data is unnecessarily prescriptive in nature. By consultation with the using service, much of the project information may be converted into performance terms, which would more accurately establish the intent of the original description. For example, if the available project information requires:

— "a rectangular, single-story, semi-permanent, pre-engineered, insulated, and metal panel structure, 40 feet wide by 90 feet long, (3,600 s.f.)",

then it should be established:

— why pre-engineered metal buildings were specified;
— why the building's length and width were defined exactly;
— what was meant by semi-permanent?

The same project information could be expressed as follows:

3,600 s.f. of space (± ____%);
Proportions varying from 30' x 120' to 60' x 60' are acceptable;
A single-story building is required for materials handling;
Exterior walls must be non-combustible and easily removable for future expansion (impact is not a problem);
The building may be permanent—if readily expandable for future growth.

The **Project Design Program**, completed as above, provides the necessary criteria for developing the design "in-house" as in the *Fixed Design Strategy*, or for governing the development of designs prepared by the proposers under the other three strategies.

1:292 HUMAN NEEDS DATA

Recent studies conducted by the *Architecture Branch* of the **Facilities Habitability and Planning Division** of CERL (as well as others) have addressed the subject of man's relationship to his built environment. Significant data have been collected and are presented in a series of reports (see 2:420).

Human needs data required for *Design and Documentation* should be obtained ahead of time—during *Programming*. For the *Fixed Design Strategy*, data compiled can be used by in-house CORPS personnel or by AE consultants in RFP/RFTPs. For the *Footprint, Package*, and *Sequential Strategies*, the data obtained should be translated into **performance** terms, wherever possible, for inclusion in RFP/RFTPs.

1:293 BUILDING SYSTEMS DATA

Procure additional systems data to supplement that obtained during the *Feasibility Study*. The data now required varies depending on the strategy selected; in particular, more detailed information is required for the*Fixed Design Strategy*. Following are guidelines for data which should be obtained (see appropriate subsection for Fixed Design or the other three strategies).

Fixed Design	**1:340**
Footprint	**1:350**
Sequential	**1:360**
Package	**1:370**

BUILDING SYSTEMS DATA: FIXED DESIGN

For the *Fixed Design Strategy*, building systems data can be obtained from the CERL/TIBS data band[1], from the BPSG data bank[2], and from individual manufacturers. CERL is presently compiling an "open system catalog" of precoordinated components for use in this strategy.

A sample computer printout from CERL/TIBS is shown in 2:431; a sample computer printout from BPSG is shown in 1:381; SEF[3] publication T-1 is recommended; "CERL/TIBS incorporates (January 1976) will cover the subsystems components developed for the EFL schools, which provide some of the most complete interfacing available. Obviously, this study doesn't include producers of boxes, panel-and-slab manufacturers, or "stick builders".

The information thus obtained should be organized under the headings of *Systems and Non-systems, Dimensional Coordination, Configuration, Tolerances, Subsystem Functions*, and *Subsystem Performance*.

[1] CERL-FHM, Box 4005,
Champaign, IL 61820
Tel: (217) 3526511

[2] Building Procurement Study Group, Department of Architecture, University of Illinois, Urbana, IL 61801

[3] Metropolitan Toronto School Board, *Study of Educational Facilities*, 155 College Street, Toronto 2-B Ontario, Canada

[4] Educational Facilities Laboratories, 3000 Sand Hill Road, Menlo Park, CA 94025

Systems and Nonsystems

Verify which subsystems are to be included in a given system, as opposed to the remainder to be treated as nonsystem. Also, identify any combination of traditional trades involved in one system, *e.g.*, lighting/ceiling or electric/electronic subsystems.

Dimensional Coordination

Identify the dimensional rules of the system, *e.g.*, planning grid, bay sizes, room heights and floor/ceiling sandwich depth.

Configuration

Identify those rules of the system which will affect the building shape,[1] including such information as:

- maximum number of stories permitted;
- slopes and diagonals;
- maximum/minimum spans and overhangs; and
- split levels and offset capabilities.

Tolerances

Identify both positional and manufacturing tolerances for each subsystem and, where possible, for nonsystem work. For example (relative to the nominal floor-to-floor height), determine the maximum/minimum:

- manufactured height of the partitions;
- deflection of the floor (under specified loading conditions); and
- the roof camber.

Subsystem Function

Identify precisely what each subsystem provides, *i.e.*, Does the lighting/ceiling subsystem include accent as well as general lighting? Identify also the precise end of one system and the beginning of another, *i.e.*. Under which section of the specifications should the air diffusion boot attachment be specified—the suspension sub-system or the HVAC sub-system?

[1] A good example of such massing rules is graphically shown in Volume 3 (**INFORMATION MANUAL,** under *Planning Concepts*) of the ABS study available at $20./set from:

Howell H. Brooks, Director
University Physical Facilities
Indiana University
700 North Walnut Grove
Bloomington, Indiana 47401

Subsystem Performance

Obtain technical data comparable to that normally required by A/E's to incorporate a manufactured product into a building design. For example, data for the structural subsystem should include:

- spans and load capabilities;
- openings: size and possible (or mandatory) locations;
- bracing required;
- fire protection required or provided.

BUILDING SYSTEMS DATA: FOOTPRINT, PACKAGE, AND SEQUENTIAL STRATEGIES

Data can be obtained for these strategies from the CERL/TIBS data bank and from individual manufacturers. The information obtained should be organized under the headings of *subsystems, dimensional coordination, configuration, tolerances,* and *subsystem performance.*

Subsystems

Verify which subsystems are to be included in a given system, as opposed to the remainder which are to be treated as nonsystem. Also identify any combination of traditional trades involved in one system, e.g., lighting/ceiling or electric/electronic subsystems. Identify precisely the boundaries of each subsystem.

Dimensional Coordination

Identify the dimensional "rules" of the system, e.g., the planning grid, bay sizes, room heights and floor/ceiling sandwich depth.

Configuration

Identify those rules of the system that will affect the building shape[1], including such information as:

- maximum number of stories permitted;
- slopes and diagonals;
- maximum/minimum spans and overhangs; and
- split levels and offset capabilities.

[1] A good example of such massing rules is graphically shown in the ABS study (see above footnote).

Tolerances

Identify the minimum-maximum tolerances for each system and subsystem, and where possible, for nonsystem work.

Subsystem Performance

Obtain typical technical data comparable to the information normally obtained by A/E consultants when incorporating a proprietary product in a building design.

1:294 PRELIMINARY LIST OF AVAILABLE BUILDING SYSTEMS

On the basis of the information obtained on the available building system, the selection of building systems can be a matter of eliminating those which are unsuitable. Depending on the building type, factors to be considered vary; therefore, the three building types are examined separately.

Housing

There are no restrictions on the type of building systems to be considered for housing. Available data cover a range of systems products from modules (or "boxes") to panel-and-slab, to variations of stick-built fabrications. File all of these data, upon receipt, for use during *design and documentation*.

Administration/Classroom Facilities

In recent years, *Adm/clr* facilities often consist of large flexible spaces which can be subdivided into a variety of spaces. If this type of flexibility is required, building systems which can be classified as "box" or "panel-and-slab" should be eliminated from consideration.

Storage

Generally, storage facilities consist of large flexible spaces with minimum surface finish. If this type of facility is required, subsystems may provide a storage facility with only the structural sub-system, a roof, exterior skin and ceiling/lighting. Most other elements are nonsystem and non-coordinated. Building systems which can be classified as "box" or "panel-and-slab" should be eliminated from consideration.

1:295 PRELIMINARY NOTICES TO INDUSTRY

Even though the *Feasibility Study* found that there were a sufficient number of potential proposers, a number of their building systems may now have been eliminated as being totally unsuitable. Notices should be sent to the remainder which have been identified as suitable:

- to determine the kinds of producers who are interested in responding so that, if necessary, *Design and Documentation* can be modified to permit the maximum number to compete fairly; and
- to give early notice of the project, to increase the likelihood of wider industry participation.

Include in this advance notice:

- the unique IBS aspects of the contract;
- an outline of the procurement procedure (*i.e.*, one-step, two-step, or formal advertising);
- a brief description of the procurement strategy, (*i.e.*, fixed design, sequential, etc.);
- the bases for contract award;
- the scheduled target dates for the different phases of the project;
- the expected date of fund allocation; and
- the general scope of the work involved.

1:296 ENVIRONMENTAL IMPACT STATEMENT

The DOD memo "Guidelines on Environmental Impact Statements," reads:

> "At the earliest practicable step in the planning process, and in all instances prior to decision, the environmental consequences of any proposed action shall be assessed."[1]

If, potentially, a project may significantly effect the quality of the human environment, or if the environmental impact of the project could be controversial, a statement entitled *"Major Action Significantly Affecting the Quality of the Human Environment"(MASAQUE)* should be prepared for review by the **Council on Environmental Quality.** (One exception: where the project forms part of a larger project which already has approval). Since there is a possible 90-day waiting period before review by the council, the impact statement should be submitted during *Programming.*[2]

Unless security issues are involved, the statement should be made available to the public.[3]

[1] DOD Policy-Responsibility, Guidelines of 102 (2), Public Law 91-190, Section 214.3, Policy.

[2] Preparation of Environmental Impact Statements, FEDERAL REGISTER, 1 Aug. 73, Vol. 38, No. 147, Part 2, (Council on Environmental Quality).

[3] Any questions on the preparation of environmental impact statements may be addressed to CERL's *Environmental Systems Branch*, CERL-ESS.

Following (in the right-hand column) are possible answers to the points required to be covered in impact statements. These answers stress possible advantages of IBS methods over conventional methods, and should be quoted in addition to those normally given.[1]

Required Points	Supplementary answers
1. Description of proposed action:	(No special IBS input here)
2. Relation of proposed action to land use plans:	(No special IBS input)
3. Probable impact on environment:	"Disposal of debris is often decreased with the use of industrialized building. Construction waste is significantly less than with conventional work. The need for the burning of scrap lumber is virtually eliminated, making a cleaner process than usual. Landfill needs are minimized."
4. Alternatives to the proposed action:	"RFP's will ask proposers to adapt their systems to minimize adverse effects" (this can be one criterion for proposal evaluation).
5. Unavoidable adverse environmental effects through proposal implementation (with possible remedies):	"With the use of prefabricated parts, a ___% reduction of construction time is being scheduled. Noise during erection is expected to be less than with conventional methods, and will be of shorter duration."
6. Relationships between local, short-term use of man's environment and the maintenance and enhancement of long-term productivity:	(No special IBS input)
7. Irretrievable commitments of resources involved in the proposed action:	(No special IBS input)
8. Contingency situations in which environmental considerations may be overridden:	(No special IBS input)

[1] An annotated bibliography may be obtained free from the American Institute of Architects' library, 1735 New York Avenue NW, Washington, D.C. 20006

1:297 CHECK LIST OF PROGRAMMING ACTIVITIES

- ☐ Define preliminary programming decisions.
- ☐ Review military regulations on the implications of using industrialized building systems.
- ☐ Check (for compliance and for necessary action):
  - MCA Program;
  - project approval;
  - waivers.
- ☐ Select the strategy.
- ☐ Select the procurement option.
- ☐ Select and retain A/E services; Check:
  - information on A/E services;
  - A/E selection criteria;
  - scope of A/E services required;
  - cost of A/E services.
- ☐ To prepare a schedule of work and determine staff requirements, check:
  - product information;
  - design and documentation;
  - proposal and evaluation;
  - submittals;
  - factory inspection;
  - construction time;
  - budget.
- ☐ Prepare project design program.
- ☐ Compile human needs data.
- ☐ Compile building systems data.
- ☐ Prepare a preliminary list of available building systems.

- ☐ Send out preliminary notices to industry.
- ☐ Prepare and submit an Environmental Impact Statement, if required.
- ☐ When authorization is received, proceed to *Design and Documentation*.

chapter three

DESIGN AND DOCUMENTATION

TABLE OF CONTENTS

INTRODUCTION

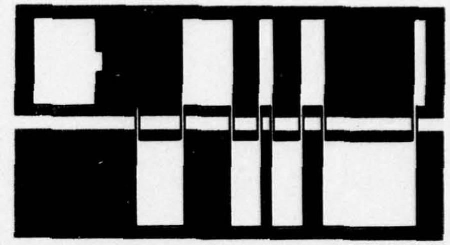
GENERAL CONSIDERATIONS

1:300 SCOPE

Following is a brief definition of the scope of **Design and Documentation.** The different ways of expressing the project design requirements (e.g., prescriptive, reference, proprietary, or performance) are reviewed, and information sources on performance specifications are listed. The first two tasks from the Programming phase are described in:

(a) a comparison between characteristics of available building systems and project design requirements, and in

(b) a comparison of the differing characteristics of the available building systems.



1:301 DESIGN/DOCUMENTATION AND INDUSTRIALIZED BUILDING

In contrast to conventional processes (where the architect prepares drawings and specs to communicate precisely what the contractor is required to build), with IBS the building system is *usually already designed, with many details fixed.* Therefore, the objective in *Design and Documentation* becomes a description of what the completed building is required to *do,* without defining precisely what the detailed solution should *be.* Instead of developing detailed drawings, the design consultants must communicate through statements and schematic drawings which describe precisely what the client or users actually need for the project. These statements and schematics also will form a base for evaluating the manufacturers' proposals. This chapter describes the various ways that user needs can be stated, which will vary with the strategy selected.

The first three sections describe how to prepare documents which accompany the body of design documentation. These are: the "Front End" documentation, the boiler plate and a list of required submissions. The subsequent four sections provide guidance on designing and documenting for the four alternative strategies. The final section describes the "end tasks" which should be carried out before proceeding to the *Proposal and Evaluation* phase.

1:302 THE COMMUNICATION OF PROJECT REQUIREMENTS

There are many ways to express IBS project requirements. The types of specification are:

Prescriptive specifications (which have been traditionally used) describe the means, methods, and materials to use in achieving the result desired.

Reference specifications refer to an existing standard that has been established for either a material, a test method or an installation procedure with regard to a specified product.

> **Ex:** Instead of describing portland cement in detail as to quality, fitness and other characteristics, the specifier should simply require that portland cement meet the requirements of ASTM C-150, Type ABC.

Proprietary or "brand name" specifications state outright the actual make, model, and catalog number of a product.

An "or equal" specification is not so much a spec as it is a clause to be added at the end of any one of the above three types of specifications. Its purpose is to allow an alternative solution to the one proposed, so long as it is "equal" to the one stated.

> **Ex:** The specification might read, "use one-piece type main casting of close grain gray iron *or equal*."

Performance specifications, simply put, set forth the desired results without restricting a proposer to any means, methods, or materials necessary to achieve those results. More specifically, it states the desired attributes of a material, components or system in order to fulfill the requirements of its use without defining the process to be employed to accomplish the desired end.

Comments on These Five Specification Types

Prescriptive specifications are incompatible with the effective and efficient procurement of IBS, as pointed out in Section 1:301, except in certain situations.[1] The exceptions are:

- If no "off-the-shelf" components exist, the disadvantages in using prescriptive specifications can be minimized.
- If "off-the-shelf" components are available, but are descriptively identical, prescriptive specifications may be effectively used.

[1]If a specification calls for an item to be 6" wide, a manufacturer might have a valid complaint if his product were disqualified for being 7" wide even though it met or excelled the performance of a qualified 6" product. An interface requirement may be the deciding factor here.

These exceptions are not all-inclusive. They merely re-emphasize that the main condition for using performance specifications—"where it is probable there will be wide variations in the design solutions"—does not always exist.

Prescriptive specifications can also be fine-tuned to be more compatible with the performance concept.

> **Ex:** Instead of specifying a 30" doorway, a performance specification may require that "a man should be able to walk through the doorway," another possibility could be that "the doorway should be between 26" and 36" wide." Though descriptive, the use of a maximum and minimum is less restrictive than a set dimension, thereby permitting different design solutions.

Reference Specifications are acceptable if the type of specification it refers to is in performance terms. If instead, the referenced spec is prescriptive then it should be treated as discussed under *prescriptive specification* (above).

Note that many reference specifications are mandatory. ASPR 1-1202, and to an extent ER 1110-2-1200 (7 (a)) and (8 (a)), require in certain circumstances the mandatory use of a "Federal" or "Military" specification or guide specification. A *problem* emerges if the mandatory specifications are prescriptive. Though the issue is not yet fully resolved, a recommended approach is to identify prescriptive specs which should be converted to performance terms, then formally request a waiver so as to alter them pursuant to ASPR 1-109.1. Such a waiver request would appear to gain the endorsement of the drafters of ASPR.[1]

Such authority seems to provide for conversion of prescriptive to performance specs. In such a case, the project manager would keep a memorandum for record, noting the specs changed with the reason for their change. However, until full resolution is verified through a policy statement, requests for waiver should be submitted through appropriate chain of command.

Proprietory or "brand name" specifications are to be used only in certain situations and pursuant to certain rules. ASPR 1-1206.2 details the parameters for using a brand name specification. Basically, where ASPR 1-206.2 allows the use of a brand name specification, its use is premised upon:

(a) listing all known acceptable brand name products, "where feasible"; and,

(b) allowing for alternate products through the use of an "or equal" clause.

Note: Underlying every prescriptive specification is a desired function. Therefore, every prescriptive specification should be susceptible to conversion to a performance specification. *E.g.*, if a specification says "no steel partitions," the reason might be because steel may rust or dent easily. Converting it to a performance specification would only require saying "no product material can be used which easily rusts or dents."

[1]On Feb. 8 and 9, 1960, DOD submitted its "Department of Defense Procurement Presentation" to the **Procurement Subcommittee** of the *Senate Armed Services Committee*. On page 20, DOD said, "...the use of performance specifications may better assure competition being obtained as, for instance, where the government requirement can be met by any one of a number of commercially designed and available products... Such a specification fosters competition in these situations and avoids the favoritism which would occur if we adopted one company's design or a government design which was more nearly like the design of one company than the other. Such a specification also avoids special retooling and production starting costs and, hence, results in lower prices to the government."

An "or equal" specification, though ostensibly clear-cut, is potentially a troublesome clause. To determine whether a product is in fact "equal" to the one specified requires that the essential characteristics of the specified product (material or method) be known—otherwise a comparison cannot be made. Therefore, "or equal" clauses should be used only where the characteristics of a specified product are known and can be articulated.[2]

Performance specifications should be used, where possible and practical, in the procurement of IBS. Performance specs may foster competition, avoid favoritism, and provide lower prices to the government by avoiding special retooling and production starting costs. Where existing IB systems offer a variety of design solutions or where a technical proposal is called for regardless of the state of the art of a particular system, a situation exists which justifies—if not demands—*the use of performance specifications*.[3]

Even if a technical proposal is not demanded and if no fitting systems exist, the use of performance specifications still is encouraged where there is a potential variety of solutions to a situation, problem or condition. The reason is that their use carries other advantages:

- by their nature, they free industry to innovate;
- they encourage or stimulate the market toward technical innovations whose benefits are then available not only to other public agencies but also to the private sector;
- they further the development of performance based standards;
- they offer a way to determine product acceptability.

Descriptive/Performance Combination

Types of specification *can* be mixed in one procurement package. However, where possible, specifications which are prescriptive in nature should not be combined with performance specifications unless:

- they are stated in terms of requesting a solution (*i.e.*, a 30"-36" doorway) instead of providing a restrictive solution (*i.e.*, a 32" doorway); or,
- a certain component is so universal that prescriptively specifying it will accommodate all or nearly all IB products.

[2]The requirement is that the product be equal in "all material respects" to the "salient physical, functional, or other characteristics...essential to the needs of the Government." ASPR 1-1206.2.

[3]DOD quote accompanying the comments on "Prescriptive Specification," this section.

An improper combination of prescriptive and performance specifications tend to cancel the benefits each offers individually. One requests a solution, the other provides a solution. Their commingled use, therefore, is innately contradictory.

Evaluation Criteria for Performance Specifications

The requesting of a solution implies that evaluation procedures will insure compliance with the criteria of the request. ASPR 2-503.1a(iv) requires that a statement be made in Step One (of a Two-Step Formal Advertising action) noting the criteria to be used in evaluating the technical proposals.

Evaluation criteria may require two procedures:

(1) Provide a preliminary section to performance specifications to review methods, means, and personnel to be used for evaluating the responses. This section can vary from a brief statement such as "responses will be evaluated by a technical team using methods of analysis to insure that performance requirements are met" to a more detailed statement listing the manuals, procedures and standards to be used in analyzing the proposals.

(2) The GSA/PBS procedure[1] communicates their performance requirements via a grid wherein "Built Elements or Subsystems" are related to "attributes." Each section of this grid is then expressed in the framework of Requirement, Criteria, and Test. For example, for the subsystem "HVAC" and the attribute "maintenance" the specification says,

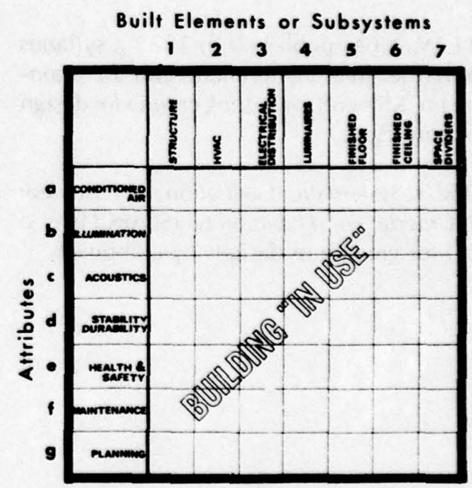
REQUIREMENT: (1) Provide accessibility.

CRITERIA: (a) This subsystem shall provide accessibility for maintenance, repair and adjustment for operations to be performed.

TEST: System prototype/observation."

[1] *Performance Specification for Office Buildings, January 1971.* See the **Public Building Service's** *Performance Specification for Office Buildings, January 1971.*

The performance specification relies on a 49-intercept matrix for development and indexing. Seven attributes are arranged in rows and as many built elements or subsystems forms the columns. Requirements and criteria are not necessarily found in all intercepts; intercepts having no requirements are indicated accordingly in the following pages.



1:303 INFORMATION SOURCES ON PERFORMANCE SPECIFICATIONS

No complete set of performance specifications exists for government work. However, information on how to state requirements in performance terms can be obtained from the following sources:

- Section 2:410 contains a *list of performance specifications* developed previously for IBS projects;
- Section 2:310 contains *references* on the development of performance specifications;
- Section 2:320 contains a *sample* performance specification.

1:304 PROJECT REQUIREMENTS AND AVAILABLE BUILDING SYSTEMS

There is a carry-over of activities from **Programming** *to* **Design and Documentation.** During **Programming,** data should have been collected on project design requirements and on available building systems. To begin **Design and Documentation,** review these data to ensure that available systems *meet the stated requirements.* If not, check to see whether the *intent* has been met. While a standard product offered by an IBS producer may not exactly satisfy a prescriptive requirement, it may provide a satisfactory solution. *If so,* the requirement should be *modified* to allow the use of that product.

If a building system *does not meet either requirement* or intent, contact its supplier to determine whether his product can be altered. Both cost and time involved for modifications should be considered. Should the supplier be unwilling to change his *product (or unable to do* so in the required time), that system is "unavailable" for the project even though the supplier may eventually find the means to alter his system to submit a bid.

Special References:
The A.I.A. *Energy Opportunities Notebook* offers, on a subscription basis, *a continuing* service on design for conservation of resources.

H.E.W./A.I.A. published in 1975 a syllabus for barrier-free environment, *Into the Mainstream* (Kliment), providing criteria for design for parplegics.

CERL's *Systematic Evaluation and Review of Criteria For Habitability* (SEARCH) is a tool for grading of designs by computer.

1:305 THE CHARACTERISTICS OF AVAILABLE BUILDING SYSTEMS

Based on data collected during **Programming**, an examination of the available systems should determine whether various building systems are measurably comparable. For example:

- are the available systems of the same type?
- are their planning parameters similar?
- are their performance levels close enough to provide fair evaluation comparisons?

When the comparison shows that available building systems (or subsystems) are very closely aligned, project requirements may be stated in prescriptive terms regardless of the guidelines put forward in this chapter.

Where the **Fixed Design** strategy is being used *for two or more types of* IB systems, assemble data relating to the performance standards of all the available systems. The planning parameters should be separated into groups for each type of system, and separate layouts developed on these bases. See 1:340

SECTION ONE

FRONT END DOCUMENTATION

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1:310 DEFINING THE PROJECT

To familiarize proposers with the unique aspects of the project, an explanation of the following topics should be included in RFP/RFTPs:

- a statement of objectives;
- an explanation of procurement procedures;
- an explanation of the contract type;
- the bases for proposal evaluation; and
- general comments.

1:311 A STATEMENT OF OBJECTIVES

The reasons for adopting innovative procurement methods should briefly be described. The statement could include such objectives as:

"Facilities at lower cost;"

"Higher Quality Construction;"

"Facilities in a shorter period of time;"

"Reduced maintenance and operating costs;" and/or

"Interchangeable components."

The *statement of objectives* should be followed by a brief review of what is required, noting the character and atmosphere desired in the final design. (See samples.) This *"aims and objectives"* statement may be incorporated (at least in part) into public notices of the project.

Statement of Objectives

Through the use of a "Two-step" procurement process the Government desires to obtain *operations, administrative* and training facilities for the Air Force. By this approach the Government desires to make use of the building industry's industrialized construction techniques in designing and manufacturing high quality, relocatable modular units at minimum cost.

In the two-step procurement proceudre the "Request for Technical Proposals" constitutes Step One. One technical proposal may be submitted by each proposer or multiple proposals presenting different basic approaches may be submitted. Upon receipt of response to this *RFTP, proposals, without* pricing, will be evaluated for design and quality conformance.

Step Two of the procurement process is the "Invitation for Bids" which is issued to those proposers who have met the requirements of Step One, the RFTP. Pricing is included, bids are evaluated and a contractor/manufacturer selected. Each bid in Step Two must be based on the bidder's own approved technical proposal and the requirements specified in this RFTP.

In this RFTP all site work outside the designated area (grassy plot) has been designed and specified in prescriptive fashion. In response to this RFTP each proposer will submit concept drawings, outline specifications and other data as required in the Submittal Requirements section and will be required to certify that all materials and equipment included in his technical proposal and subsequent design and construction meets or exceeds the minimum requirements specified herein.

A pre-proposal conference for *the purpose of discussing* any points in question will be conducted thirty (30) days after issuance of this Request for Technical Proposals. The pre-proposal conference will be held at 10:00 a.m. local time, 1 June, 1972 in the Public Service Auditorium, First National Bank Building, 1401 Elm Street, Dallas, Texas.

Although questions from the floor will be answered at this conference, it is recommended that proposers mail in their questions to the address listed below, on or before 24 May, 1972, to allow the Corps of Engineers and the Architect-Engineers time to research the questions prior to the conference.

Prospective Proposers are requested to mail notification as soon as possible of their intention to attend the pre-proposal conference to:

Department of the Army
Ft. Worth District, Corps of Engineers
819 Taylor Street, P. O. Box 17300
Fort Worth, Texas 76102
Attn: Contracting Officer, RFTP No. DACA63-72-R-0007

Project Distinctions

Through the use of a "One-Step" Procurement process, the Department of the Army desires to obtain 250 housing units for bachelor officers at Ft. Knox, Kentucky. By using the "One-Step" Method of procurement, this program is designed to test the ability of industrialized housing systems producers to meet the requirements of the Corps of Engineers for high quality, well designed, non-combustible *housing, to be delivered on a demandingly* tight schedule.

Prospective bidders should be prepared to demonstrate that their housing systems meet the requirements of being:

A. Building systems in which the major components or parts and *the rules for their assembly are responsive* to an established set of requirements: and

B. Industrialized in that the system is organized to convert raw materials into products by capital-intensive activities such as mechanization and automation, as opposed to labor-intensive activities such as organized handicrafts.

Location of the industrialized building process can be *either* on or off the building site, or may involve mechanized or automated production of the buildings in place.

In this "One-Step" procurement procedure consideration will be given simultaneously to the qualifications of the Offeror, his Proposal, *and to the cost implications of that Proposal.*

Offerors will be asked to submit complete proposals for the design and construction of the Project, which will be evaluated in the categories of Design, Technical Performance, Life Cycle cost, and Contract Price through the use of a point and weighted value scoring system. Offerors will be furnished the weighting values of the evaluation criteria as part of *the bidding documents. In addition, offerors* will be furnished unit values for the Life Cycle Cost Analysis evaluation procedure. Final selection and basis for award of the Construction Contract will be to the proposal receiving the highest cumulative total point score of all proposals submitted. This is not a low bid award project.

For this project, all site development work outside the building location areas *has been designed and specified in prescriptive fashion.* In response to this RFP, each offeror will submit design drawings for the buildings and all sitework within the building location areas, technical specifications, lump sum price for all design and construction work, and other data as required in the proposal form.

OPNS-ADMIN-TRNG

Section 1B • PROCEDURE FOR PROCUREMENT

GENERAL:

1. It is the intent of the Government acting by and through the cognizant Contracting Officer of the U. S. Army Engineer District, Fort Worth, to procure the design and construction of desired facilities by two-step formal advertising as authorized in Part 5, Section II, of the Armed Services Procurement Regulation. The procedure to accomplish such procurement under the said regulation is as follows:

STEP ONE: REQUEST FOR TECHNICAL PROPOSAL (RFTP)

2. A Request for Technical Proposals will be distributed to qualified sources for the design and construction services as necessary to assure full and free competition consistent with the Government's requirements and to conform to the Contract requirements and Criteria.

3. No cost or pricing information shall be included by the Proposer in the Technical Proposal.

4. The Technical Proposal shall be in conformance with the Submittal Requirements Section and submitted in the form shown in the form shown in Appendix Z.

AMENDMENTS TO RFTP:

5. The right is reserved as the interest of the Government may require, to revise or amend the Request for Technical Proposal documents, or any part thereof, at any time. Such revisions or amendments, if any, will be furnished by an Amendment or Amendments to the Request for Technical Proposal documents. Copies of such amendments will be furnished to all prospective Proposers. Prospective Proposers are required to acknowledge receipt of all Amendments to the Request for Technical Proposal Documents giving the number and date of each.

EVALUATION OF PROPOSALS:

6. In Step One of this two-step procurement, Proposers are authorized and encouraged to submit multiple technical proposals presenting different basic approaches. Each technical proposal submitted will be evaluated separately and the Proposer will be notified as to its acceptability.

7. If necessary, the Contracting Officer will arrange for discussions with Proposers who have submitted Technical Proposals, for the purpose of obtaining additional information or clarification.

O-A-T
1B-1

1:312 AN EXPLANATION OF THE PROCUREMENT PROCEDURE

The distinctions between conventional processes and the contract type being employed should be described, concentrating on the aspects which affect proposal preparation as well as post-award operations. *Since contracting officers have the responsibility of providing the bidders with an adequate description of the services needed, care should be exercised in describing the responsibilities of the proposer. This task becomes more difficult but more important when a performance rather than a prescriptive approach is adopted.*

Some unique aspects which should be noted:

- the team approach in IBS, especially that design responsibility is shared between the Corps, the AE consultant and the proposer;
- that the RFP/RFTP *does not constitute the construction documents;* their preparation is the responsibility of the proposer after the award of the contract;
- the approval of the final design is required before construction can be authorized;
- the time frames for the various phases which have to be observed, relating these to the strategy which has been chosen.

See ASPR 18-202 *Preparation of Information/Instructions for Bidders (IFBs)*

1:313 AN EXPLANATION OF THE CONTRACT TYPE

The unique aspects of the procurement option should be explained to proposers.

For One-Step, include these statements:

"Evaluation categories to be used are building function, technical performance, life-costs and initial costs. (Add, if applicable, energy conservation, environmental concerns and esthetics.) "Though proposers will be notified of evaluation results, all details – except for total evaluation scores – will be kept confidential. Exceeding minimum standards is encouraged, but any proposal below the standards defined in RFP specifications may be deemed non-responsive and categorized as unacceptable."

The proposers should be informed of the relative importance of weights of the different design criteria in the evaluation process. This allows proposers to tailor their submissions accordingly. However, a tabulation of exact or detailed weighting by numerical percentages should *not* be included.[1]

For Two-step, include these explanations:

"Step One: RFTP submissions are evaluated only for design and technical performance aspects. Approval of these submissions is prerequisite to Step Two submissions.

"Step Two: Approved Step One proposers are requested to submit cost proposals, with final selection based solely on the lowest bid.

"Refer to other RFTP instructions on procedures to be followed and information to be included to qualify a proposal to be classified 'responsive'."

[1] *To prepare this information on the evaluation process, there is overlapping work between the Design and Documentation phase and the Proposal and Evaluation phase. Preparation work for the evaluation procedure should be carried out simultaneously with RFP/RFTP development. See 1:422.*

For Competitive Bidding, include these statements:

"Submissions shall be in three separate packages for reviews by evaluators to determine:

- that the proposer is *responsible* (mark this envelope 'certifications');
- that his proposal is *responsive* (identify these documents as 'the proposal');[1]
- the cost *breakdown* (label this, in an opaque envelope, as 'the bid').

"Names of proposers shall be deleted from documents to assure unprejudiced evaluation."

1:314 AN EXPLANATION OF THE PROPOSAL EVALUATION

The expanded evaluation process should be explained to the proposer. Recommended statements for inclusion in the RFP/RFTP are:

"Proposals will be evaluated by a panel of government representatives by methods here described; final decisions rest with the Contracting Officer.

"Proposals will be evaluated separately (not judged competitively) on the basis of their responsiveness to the RFP/RFTP.

"Since the evaluators' judgments will be final, proposals should clearly show that all aspects of the project requirements—esthetic, technical and functional—have been considered and met in their proposals.

1:315 GENERAL COMMENTS

Proposers should be informed that proprietary information can be kept confidential, except for that in the winning proposals. They should also be directed to note aspects of their proposal which tend to minimize adverse environmental effects.

[1]Mandatory Coverage of Evaluation Criteria, *Procurement Circular, No: 110, (30 May 73).*

Value Engineering

Since the purpose of IBS is to elicit the best that industry has to offer in response to an RFP/RFTP, the use of value engineering (VE) *per se* is redundant. Unless the project exceeds $1 million (in which case value engineering is compulsory)[1], the clause should be deleted from the *General Provisions*. Care should be exercised to ensure that cost-cutting through VE proposals is not accompanied by a deterioration of design quality. *Any VE proposal must be evaluated on* the same basis as was the original proposal.

[1] *ASPR 1.1702.3 (b.1.III)* Use of Incentive and Program Clauses.

SECTION TWO

BOILER PLATE

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1:321 THE WORDING OF THE CONTRACT

Because of unique IBS procurement procedures, special consideration should be given to the wording of the contract. The six essential elements of a contract are noted here, with IBS ramifications.

Lawful Purpose: The intent behind the document must be set forth in legally binding terms. Since IBS is distinctive in both process and product, their distinctions must be "spelled out."

Competent Parties: Because changes of status among IBS manufacturers have been more frequent and varied in comparison with the industry-at-large, bonds of suretyship must especially be validated.

Clear Terms: If the wording is ambiguous, the contractor's reasonable interpretation will likely prevail. Even the simplist ambiguity in wording may cause unnecessary confusion, since the contractor must ask for clarification and the Corps must respond to his request. With the development of IBS methods, a new or modified vocabulary has emerged; to avoid misunderstanding, key terms should be defined in the contract documents (2:511).

Offer: The wording should be precise to communicate the complete scope and nature of the project. The offerer must also be required to exhibit a present intention to be bound.

Acceptance: The acceptance must not modify the offer; it is does, it must be considered "non-responsive." With IBS procurement, requirements may be defined in performance terms. In these instances, proposers must be told that the responsiveness of the bid will be determined with greater care than usual in order to avoid inferior substitutions.

Proposers should be informed that although they will be preparing construction documents after contract award, requirements defined in the RFP/RFTPs will not change; it becomes more important, therefore that technical proposals can be certified as *responsive.*

Consideration: The statement of contract costs should vary from conventional practice only in the nature of the contingencies, but even these can be tabulated similarly, using standard forms.

1:322 INFORMATION SOURCES

For further information on contract clauses for military IBS projects, consult:

- the RFPs prepared by Caudill, Rowlett and Scott, A/E consultants for the Army's Fort Knox BOQ project.
- the RFPs prepared by Heery and Heery, A/E consultants for FY72 AF/IB projects.[1]

Key contract clauses are tabulated in Section 2:220; differentiation there is made between mandatory and minimum requirements.

Some standard GSA forms are also useful for IBS work:

- GSA 19-B (Representations and Certifications);
- GSA 20 (IFB/Construction Contract);
- GSA 21 (Bid Form);
- GSA 22 (Instructions to Bidders/Construction Contract);
- GSA 23 (Construction Contract);
- GSA 23-A (General Provisions VIII, Part G: Authority for Additions).

[1]For addresses, see 2:120 and 2:130

1:323 PROPOSER REIMBURSEMENT

The monetary arrangements should be explained in detail. For One-step and Two-step options, the amount of funds authorized for the project should be stated.

Partial Payment for Factory Work

Progress payments for IBS projects should be based on the work at the factory as well as on site. Where significant factory fabrication may precede site deliveries or installation, progress payments become more difficult to calculate but, more important, to keep the producer solvent. A *Special Provision* should be inserted to provide such progress payments so that the contracttor's fiscal base of operations is not endangered[7] [8]. In connection with the special need for progress payments, the attention of the proposer should be drawn to *discounts*, Paragraph 26, General Provisions[9]; this may encourage a better price to the government.

Penalties and Rewards

While liquidated damages have always been a problem to administer, projects budgeted over $25,000. require the inclusion of such a clause.[1] This simply constitutes an advance notice of the target date for completion, and damages then have to be proven. In some private IBS work, maximum damages of 1/10th of one percent per day have been set.

As alternative to the above penalty clause, some private IBS contracts have rewarded early completion with a portion of the construction costs which were realized as savings through an earlier date of occupancy or lowered interest on construction loans. It appears that the government does not allow such rewards, although credits may be given (e.g., of a given dollar amount per day) against a proposer's bid, provided he states that he can deliver ahead of schedule by a specified number of days. ■

[7] *ASPR E-504.3 and 4.*

[8] *GP 7, 10, 27, 30, 32, 45, 50.*

[9] *ASPR 7-103.14; Item 16 of GSA Form 33*

[1] ASPR 18-113.

SECTION THREE

REQUIRED SUBMITTALS

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1:330 INITIAL SUBMITTALS

To define precise guidelines on submittals for each strategy and each procurement option would be impossibly complex. The following recommendations are general and will have to be tailored for each project. The submittals required of proposers are:

- those which would initially accompany proposals, and
- those required following contract award.

Initial submittals relate to

- responsibility of the proposer,
- those concerning scheduling, and
- those verifying responsiveness.

1:331 PROPOSER RESPONSIBILITY

Generally, to encourage industry response, certification requirements should be kept to a minimum. Conforming with ASPR 1-903, the proposer should initially be required to submit:

- a DD Form 1524 (Pre-award Survey of Prospective Contractor) or approved facsimile, to provide a checklist of proposer qualifications;
- the AE's registration vitae, along with a statement that the design of architectural, mechanical, electrical and civil engineering features will be under the direction of an A/E registered in the state or jurisdiction for which the project is scheduled;
- a list of IBS projects completed by the producer which can be inspected for quality and performance (If the producer does not have this experience, call for evidence of his having been in production for a least two years. In lieu of these requirements, demand a prototype building.);
- a list of the manufacturing plants which are to be used, stating their capacities and locations. (This submission is particularly important if the building subsystem approach has been adopted or if several consortia of firms are bidding on the project.)

Bonding

With aggregated projects, there is a danger that some proposers (who are otherwise qualified and responsible) may be eliminated because of their limited bonding capacity. If the scope of the project is several million dollars, proposer responsibility can still be certified by reducing the traditional percentages for **bid bond** (normally 20% of the proposed price, submitted with the bid), by reducing the **performance bond** (normally 100% of the contract price) and by reducing the **payment bond** (normally 40% of the contract price). Also, performance and payment bond submissions can be delayed until after bid opening, so that their preparation does not interfere with the hectic production of proposal submissions.[1]

[1]*ASPR 10-102.1:* Bid Guarantee
ASPR 10-103.1: Performance Bonds
ASPR 10-103.2: Payment Bonds

1:332 SCHEDULING

With simultaneous factory fabrication and site work, scheduling becomes very critical. The governing time frames should be clearly stated, especially those which are significantly shorter than with conventional practice. GP paragraph 63, *Progress Charts*, should be expanded and a section on "Schedules and Schedule Reports" should be developed. The topics discussed include *Scheduling Networks, Reference Guides, Time of Required Submission, and Specific Requirements*.

Scheduling Networks

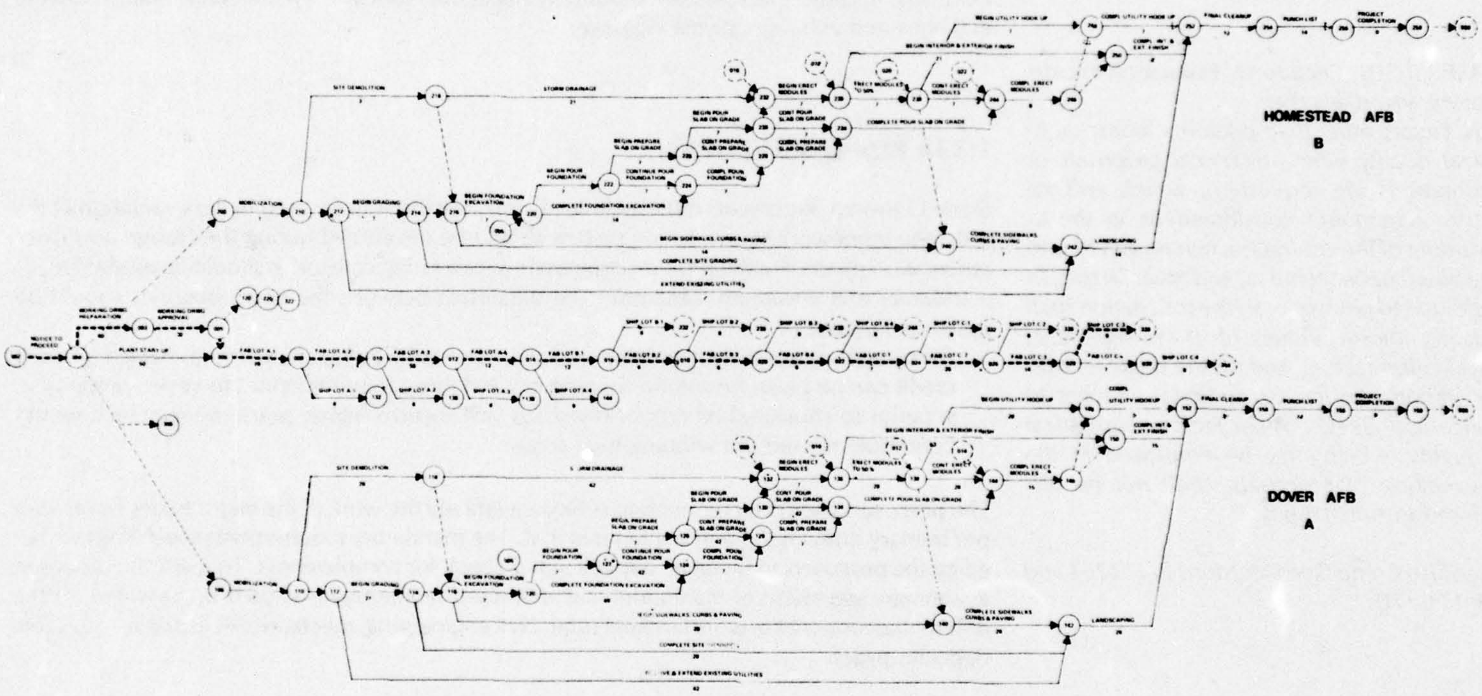
A scheduling chart should be required as part of the RFP/RFTP. The chart should contain more detail than the traditional bar chart and preferably Critical Path Method (CPM) should be adopted[1]. The proposer should be required to adhere to this calendar or submit one of equal detail with his proposal. The producer has to show that the work has been adequately precoordinated.[2]

[1]Ref.: Appendix I, ER-1-1-11, *Network Analysis System*

[2]Other techniques which are used in the industry include PERT and LOB, which are described in these references:
Program Evaluation and Review Technique: Project Management With CPM & PERT, 2nd Ed., Joseph J. Moder and Cecil R. Phillips, Van Nostrand Reinhold, 1970.
Line of Balance: Scheduling Handbook, James J. O'Brien, McGraw-Hill, 1969; *Management Program Planning and Control*, Anthony L. Iannone, Prentice-Hall, 1967.

Time of Required Submittals

The scheduling network should be required as part of the first step in a Two-step procurement, or a part of the bid/proposal in One-step procurement.



HOMESTEAD AFB
B

DOVER AFB
A

Specific Requirements

A comprehensive project may require a hundred or more CPM activities especially if there are multiple shipments and a number of different sites. The proposers should include in their schedule chart such aspects as sequences of work and deadlines for purchasing, assembling, inspection and transportation. In addition, methods of comparing planned schedules with actual performance on the charts should be given. If there is extensive subcontracting to a number of suppliers, the procurement inputs from these subsystems should also be shown on the chart. In short, this schedule should delineate the fabricator's plan, coordinating all work activities and assuring against slippage.

1:333 RESPONSIVENESS

Since One-step documents must include all considerations to be used in the evaluation of the bids, the framework for the rating system should be developed during the *Design and Documentation* phase. For the project requirements, two rating categories should be established—mandatory and minimum standards. The difference between the two categories should be stated as follows:

> "Proposals must satisfy *mandatory requirements* to be judged responsive, though no extra credit can be given for solutions going beyond those requirements. However, proposals superior to stipulated *minimum standards* will receive higher point scores which would contribute toward the winning total score."[1]

The proposers should be required to submit separately the work of the major trades covered in preliminary drawings and in written material. The mandatory requirements should be tabulated by the proposers to facilitate a quick initial check for completeness. To assist the proposer, a summary statement of mandatory and minimum requirements should be provided for the different sections of the work (architectural, civil engineering, mechanical/electrical—see table, opposite page).

[1]*ASPR 3-501, Section D,* Evaluation Factors for Award, states that:
"(i) factors other than price (including technical quality where technical proposals or quotations are requested), which will be given paramount considerations in the awarding of the contract; when an award is to be based upon technical and other factors, in addition to price or cost, the solicitation shall clearly inform offerers of (i) the significant evaluation factors, and (ii) the relative order of importance the Government attaches to price and all such other factors. Numerical weights, which may be employed in the evaluation of proposals, shall not be disclosed in solicitations."

See also Comp Gen Decisions B-172261 and B-170220.

PROPOSAL INCLUSIONS

		architectural	structural civil engineering	mechanical and electrical
PRELIMINARY DRAWINGS	mandatory requirements	⅛" floor plans and elevations typical constr'n details of proposed systems, w/o specific dims. adjacency requirements	site plan @ 1" = 30' w/ ground floor elevations noted for each structure structural schematics necessary areas	
	minimum standards	interfacing requirements alternate panel inserts interchangeability possibilities	traffic patterns site amenities	HVAC, elec. and plumbing schematics for ADM/CLR and STORAGE open systems, definition of subsystems (plumbing/wet cores or ceiling/lighting/HVAC)
WRITTEN MATERIAL	mandatory requirements	generic material descriptions unique features of system fire safety req't	interfacing requirements affecting site & foundation work	HVAC equipment selection data proposed manufacturers for major equipment (motors, panels)
	minimum standards	distinctions between performance and prescriptive response technical criteria for subsystems	ecological considerations	significantly superior technical criteria energy conservation

POSSIBLE TABULATION OF REQUIRED SUBMITTALS

This table can serve only as a general guide for what should be required of proposers. It will be necessary to tailor it to fit the needs of each particular project.

To encourage response from a variety of systems producers, dimensional variations should be permitted where possible. Allow 10% leeway on dimensions on both plans and elevations, unless certain measurements are critical; label those which must be held as "mandatory".

Site Design

To assist proposers in the preparation of their submissions, a set of A/E-prepared reproducible site drawings may be provided, with an adequate charge (for all but the Package Strategy). The proposer should either submit these site drawings unchanged or suitably modified to conform to his proposal. Because design responsibility for the site work is shared with the producers, the proposer should be required to inspect the site. Arrangements for the site visit should be specified and the proposers should be able to verify their visit.[2]

Bid Samples

If proof of product interface is prerequisite, bid samples or interfacing details should be required. If the Two-step procurement option has been adopted, this requirement should be delayed until the second step of the procedure.[3]

Bid Preparation: One-step

The bid information should be requested in a format which can be easily transferred to DD Form *1501-1, Abstract of Bids–Construction. Any items with unusual standards should be ex*cluded from the basic bid. With an aggregated program, alternate bids should be given for the individual projects. Since *Design and Engineering* (D & E) costs are excluded from the total cost of bachelor housing and storage, require the contractor to provide an accounting of *his* D & E costs (in preparing the IBS construction documents), so that these can be subtracted from the project cost.[4]

Life Costing

Obtain the latest instructions from OCE (DAEN-MCE-D) on life-cost calculations.[5]

Guarantees

As a minimum, all warranties normally provided in commercial practice should be required. *To obtain higher quality over a longer period of time,* some IBS programs require extended maintenance by the suplier firm on certain subsystems as a part of the initial contract cost[6] If more than one year's warranty on any subsystem is required, a*Special Condition* should be prepared and elaborated on in the appropriate specification. (One potential problem area for military buildings: any amount of non-contractor (*i.e.* owner) maintenance can invalidate a maintenance contract.)[7]

[2]*ASPR 7-602.4,* Differing Site Conditions.

[3]ASPR 2-202.4 and 5, Bid Samples and Descriptive Literature.

[4]DD Form 813

[5]An annotated bibliography on life-costing is available from the library of the American Institute of Architects.

[6]*A five-year guarantee was required for HVAC subsystems on the SCSD schools. Such on-going guarantees make suppliers assure themselves that their product will last.*

[7]*ASPR 15-205.9* Depreciation; *ASPR 15-205.20* Maintenance & Repair Costs; *ASPR 15-107* Advance Understandings on Particular Cost Items; *ASPR 3-402.1* (c) *Construction Plant & Equipment; ASPR 7.604.4* Construction Warranty

1:334 POST AWARD SUBMITTALS

Following the tabulation of submittals required with the proposal (above,) list those required from the contractor upon award and prior to construction. Some of these (covered in more detail below) are:

Submittals relating to *responsibility:*
- Receipt of Bonds

Submittals on *scheduling networks*

Submittals verifying *responsiveness:*[1]
- Structural plans, details and calculations,
- Mechanical plans, design and analyses, and details,
- Electrical plans, power and lighting load analyses,
- Fullsize mockups

Submittals concerning *quality control:*
- Product certification,
- Certification of materials and workmanship,
- Samples,
- Guarantees

Submittals for *owner's use:*
- Unit prices,
- Spare parts catalogs,
- Maintenance booklets,
- Directions on Disassembly and Relocation

[1]These "responsiveness" submittals supplement the TP to complete the construction documents.

1:35 PROPOSER RESPONSIBILITY

Bonds: Both performance and payment bonds are due after the bid award. See Section 1:331.

1:336 SCHEDULING

If the network analysis system required with the proposal was incomplete (e.g.,, if LOB data for factory fabrication is not included), these data should be provided upon the award of the contract for use in the administration of the contract.

1:337 RESPONSIVENESS

The following information should be obtained from the contractor:

Structural Data: Complete ⅛" floor and foundation plans, ⅛" framing plans, design loads and calculations, and possibly design drawings of volumetrics or components forming an integral part of the completed project;

Mechanical Data: A site plan at 1" = 30', ⅛" floor plan with HVAC zones, plumbing concept drawings, mechanical concept drawings, a ⅛" typical building section (showing supply and returns, chases, plenums and interstices), and brief design analyses, including heating loads;

Electrical Data: A 1" = 30' site plan, and ⅛" *floor* plan with diagrams of electric-electronic work, and brief design analyses of lighting and power requirements.

The structural, mechanical and electrical data should be accompanied by statements on codes, standards and manuals used by the contractor in each case. If needed to verify the final product, require the producer to submit product literature, catalog data and lab test reports. For evaluation, the contractor should be required to supply plans in the form of two sets of prints and one set of "reproducibles."[1]

[1] *H & H's FY72/AF RFTP, Appendix Z; CRS' Fort Knox BOQ, Section 1-C.*

Full-Size Mockups

Where the size of the project warrants the checking of a new combination of components, the construction of a prototype should be specified. This is especially needed if shop drawings or models cannot assure the coordinated performance and flexibility of subsystems. The size and complexity of the mockup could vary from a single intersection mockup of the subsystems involved to a complete prototype building. This prototype can be used to set quality standards for the remainder of the units to be manufactured. If appropriate, it could be permitted as the last unit of the entire project—this is particularly fitting if the project includes volumetrics.

1:338 QUALITY CONTROL

Product Certification

To assure the technical performance of the products, one of the following should be required:

- proof that the product complies with an ASTM standard or other recognized industry standard;
- a record of one year's experience in an actual installation.

Certification of Materials and Workmanship

For the *Fixed Design* strategy, in addition to the normal shop drawings, drawings should be requested showing the coordination and interfaces between subsystems (e.g. ceiling/lighting/partitioning/sprinklers/HVAC). This "proof of interface" (both physical and functional) is necessary to assure "whole system performance."[1]

Samples

For the *Fixed Design* strategy in particular, samples are needed to assure that any combinatior of components and surface materials will be harmonious and compatible.

[1] *"Whole system performance" may be an instance of the whole's being more than the sum of its parts (as in a structural subsystem). Or, in some instances, it may be a case of the whole's being only as good as the weakest link (as in the STC rating for an exterior wall* having opaque and glazed portions, with an integral A/C unit)

1:339 BUILDING USE

Unit Prices: The contractor should be required to furnish prices at which all subsystem parts and components may be procured during the tenure of the contract. These prices may provide cost bases for additional units if an open plan is modified, or for stockpiling against the day when the product is obsolete and no longer available.

Spare Parts Catalogs: A spare parts list should be requested for the more important subsystems, including the ceiling-lighting subsystem, the partitioning, the HVAC, and possibly the sprinkler, structural, elevated flooring and building enclosure subsystems. If remodeling to accommodate changing functions is likely (as may be required with ADM/CLR), a basic minimal supply of parts and components (perhaps 15% over the first need) should be called for as a part of the initial construction contract.

Maintenance Booklets: Require two copies of maintenance booklets (properly bound to withstand wear and tear) and any special tools needed for movement and maintenance of IBS partitions or other subsystems.

Directions on Disassembly and Relocation: If relocatability is required, call for a straightforward booklet explaining the sequences of the whole process, graphically illustrated.

Proceed now to the coverage of the particular strategy chosen:

Fixed Design	1:340
Footprint	1:350
Sequential	1:360
Package	1:370

SECTION FOUR

FIXED DESIGN STRATEGY

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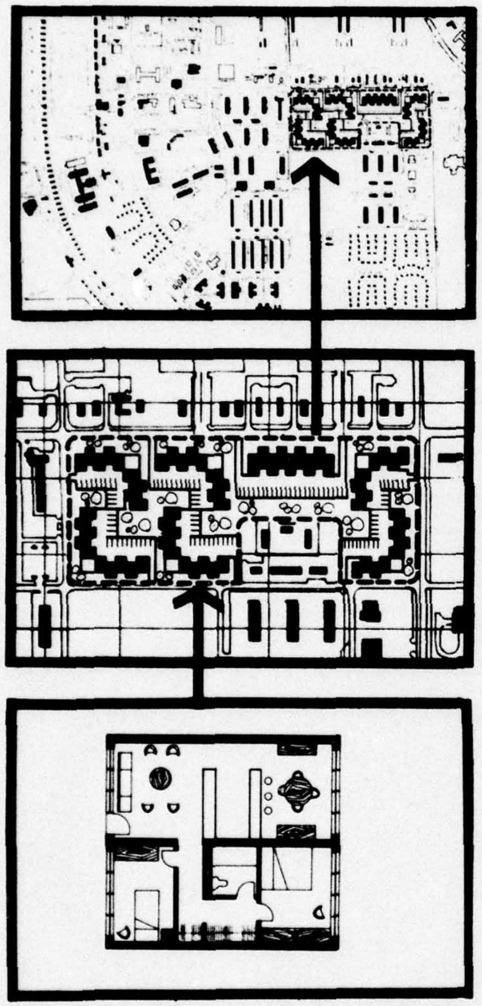
1:340 GENERAL DESCRIPTION: FIXED DESIGN STRATEGY

(This section is continued from section 1:338.)

In this phase of the Fixed Design strategy, design and develop RFP plans and specifications for the site, and the building(s). Develop RFP requirements for the building which will allow proposers having similar systems to respond competitively. This will assure maximum control over the building, site and utilities while assuring maximum response from similar systems.

Organize the technical section of the specification to conform with the arrangement of requirements presented in this section. The diagram on the following page illustrates this structure. It is an expansion of the diagram first presented in programming and on which the project requirements are based (Subsection 1:291). A brief verbal description and illustration of what each set of requirements involves is found on the left of the diagram.



Project Requirements relate to the entire work to be performed at this time. Such requirements include the context or the existing conditions and master planning considerations which define the desired relationship between existing facilities, the facilities currently being constructed and future facilities.

Site Planning Requirements affect the way in which the building may be situated on the site. These will include any special activities or physical characteristics of the site which affect

Site Subsystems Requirements describe the sitework subsystems sufficiently to allow the proposer to develop a proposal.

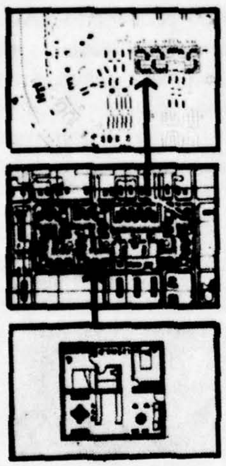
Building Planning Requirements include adjacency requirements of functional groups, circulation requirements, and any restrictions in building configuration.

Building Subsystem Requirements describe the subsystems sufficiently to allow the proposer to develop a bid and construct the buildings.

		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
PROJECT REQUIREMENTS	CONTEXT	●			
	MASTER PLAN CONSIDERATIONS	●			
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS	●			
	CIRCULATION - PEOPLE, VEHICLES	●			
	BUILDING ADJACENCY	●			
	UTILITY AVAILABILITY	●			
SITE SUBSYSTEMS REQUIREMENTS	GRADING	●			
	PLANTING	●			
	PAVING	●			
	WATER	●			
	SEWER	●			
	ELECTRICAL	●			
	COMMUNICATIONS	●			
BUILDING PLANNING REQUIREMENTS	RELATIONSHIP OF SPACES	●			
	CONFIGURATION	●			
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●		
	VERTICAL + HORIZONTAL STRUCTURE		●		
	VERTICAL TRANSPORTATION		●		
	ROOF		●		
	EXTERIOR WALLS		●		
	INTERIOR SPACE DIVISION		●		
	HVAC		●		
	ELECTRICAL	●			
	PLUMBING	●			
	LIGHTING		●		
	COMMUNICATIONS	●			

The diagram on this page indicates the recommended structure of requirements and the best way to express each requirement for this strategy.

Read through this entire section and the section on developing a rating system, (Ref. Subsection 1:422) prior to commencing work on any part of the technical RFP/RFTP. Then using the program developed earlier (Subsection 1:291), proceed to develop RFP/RFTP requirements and criteria as indicated. Do not hesitate to develop requirements in a different order than they are discussed here, e.g., skip to unit space requirements after developing site requirements where this proves easier.



Developing RFP Requirements

In the Fixed Design strategy, requirements included *in the RFP will provide control of the floor* plan, site plan and overall building configuration. The building products and methods used by the various proposers in response to subsystem requirements can be expected to vary substantially. Use the guidelines which follow to develop an understanding of the available systems, and *to facilitate preparation* of the design and written requirements to be included in the RFP.

1:341 PROJECT REQUIREMENTS

Incorporate project requirements when developing the project design. Review the system for special requirements that may bear on the project's relationship to the overall site locations, e.g., will rail sidings be required for large component delivery, or will special routing to the site be required *due to component size or weight. These are not* expected to influence the project design, but should be given attention to prevent problems.

PROJECT REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	CONTEXT	●			
	MASTER PLAN CONSIDERATIONS	●			

1:342 SITE PLANNING REQUIREMENTS

Incorporate all site planning requirements in the site contract documents in the traditional manner. Parking, grading, walks, drainage, utilities, etc. can be shown on drawings and specified as they would for conventional design.

Review the systems for any special requirements concerning:

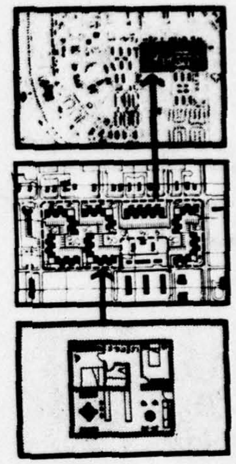
Transportation — *e.g.,* size, weight, means of arrival and movement about the site.

Storage — e.g., space required for component storage prior to erection.

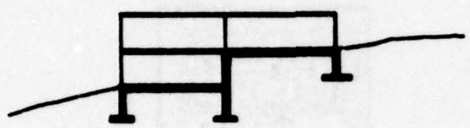
Production — *e.g.,* on-site production requirements.

Erection — e.g., requirements due to size, weight and erection techniques and equipment.

Incorporate these requirements when developing the site design, and when specifying provisions for handling and erection.



		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS	●			
	CIRCULATION - PEOPLE, VEHICLES	●			
	BUILDING ADJACENCY	●			
	UTILITY AVAILABILITY	●			



1:343 SITE SUBSYSTEMS REQUIREMENTS

Design and specify the site subsystem as conventionally done. Site drawings differ only where the building system layout occurs. Define all interface conditions between site subsystem and the building systems work.

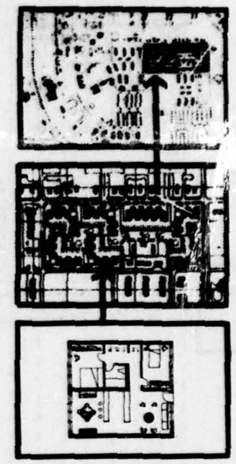
Inform the proposers through *design and documentation* of any rules for developing relationships between the building system and the site requirements. For example, how must grade at the building meet the foundation or exterior walls?

SITE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
GRADING	●			
PLANTING	●			
PAVING	●			
WATER	●			
SEWER	●			
ELECTRICAL	●			
COMMUNICATIONS	●			

1:344 BUILDING PLANNING AND SUBSYSTEM REQUIREMENTS

Plan the building in the traditional manner, but in doing so, cause the design to reflect the advantages as well as the limitations of the systems.

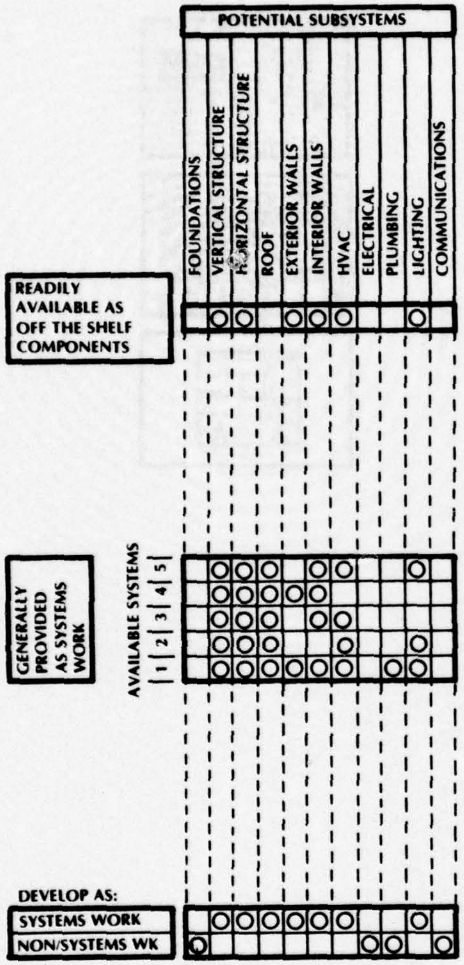
		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
BUILDING PLANNING REQUIREMENTS	RELATIONSHIP OF SPACES	●			
	CONFIGURATION	●			
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●		
	VERTICAL + HORIZONTAL STRUCTURE		●		
	VERTICAL TRANSPORTATION		●		
	ROOF		●		
	EXTERIOR WALLS		●		
	INTERIOR SPACE DIVISION		●		
	HVAC		●		
	ELECTRICAL	●			
	PLUMBING	●			
	LIGHTING		●		
	COMMUNICATIONS	●			



When developing the building design, it is necessary to:

Determine systems vs. non-systems work.
Thoroughly understand the system before starting design.
Make maximum use of the system.
Use the system to advantage, but within its limits.

The following examples illustrate these considerations.



Systems vs. Non-Systems

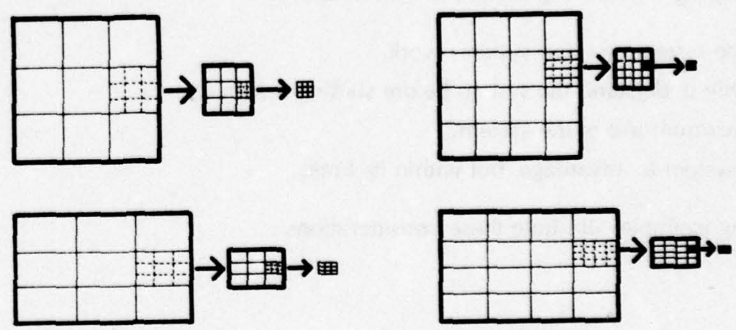
Determine from information obtained during programming which subsystems are customarily provided by each of the available system suppliers.

In the hypothetical example shown in the margin on the horizontal and vertical structure, subsystems are provided by all available systems. In this case no check is needed to determine the available systems, nor is it necessary to determine the availability of off-the-shelf structural subsystems. It logically follows to develop horizontal and vertical structures as systems work, since these are customarily provided by all available systems.

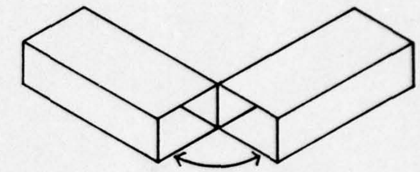
Interior partitions, on the other hand, are customarily provided by only four of the five available systems. In this case it is necessary to check to see whether interior partitions may be readily obtained "off-the-shelf" from independent suppliers in the project area. This will indicate the possibility of the remaining systems proposer offering a "locally purchased" interior partitions subsystem which he customarily does not provide. In the example, interior partitions are available. This analysis would, therefore, conclude that partitions should be developed as systems work.

Module and Grid

Establish a module to which the available building systems can respond. Where the available building systems are frame or panel systems, a modular planning grid can frequently be utilized. There are various ways of establishing a grid, which can either take a square or rectangular shape as illustrated below.



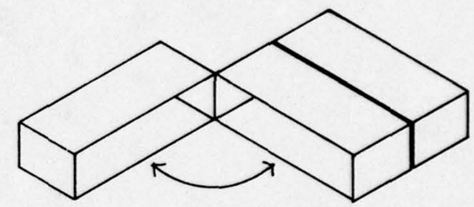
When the available systems are volumetric, the modular considerations will be quite different than for panel or frame, and the module then will relate to the dimensions of the manufactured volumetric. The module may or may not accommodate sub-modules for planning the interior space division, but the volumetric module will primarily act as a means for combining units to achieve a larger interior space.



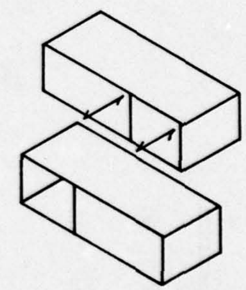
When planning with volumetrics, consider these questions:

Is there a sub-module within the volumetric?

Can the volumetrics be joined at modular intervals?

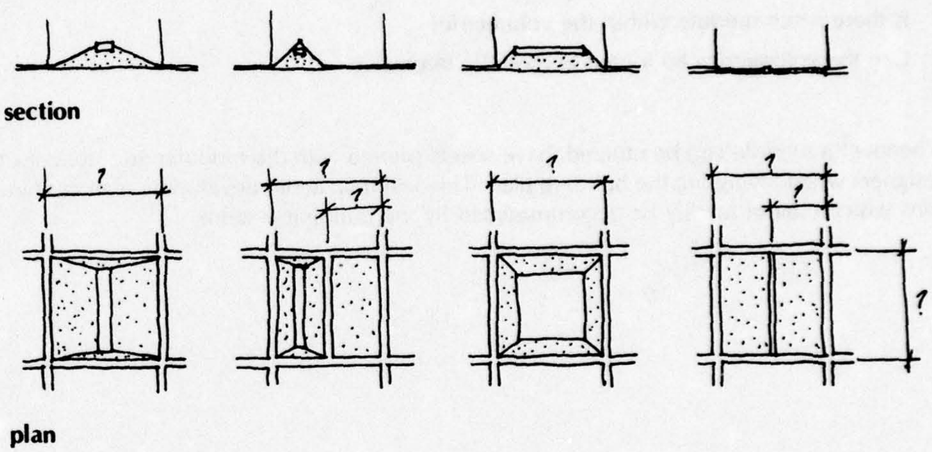


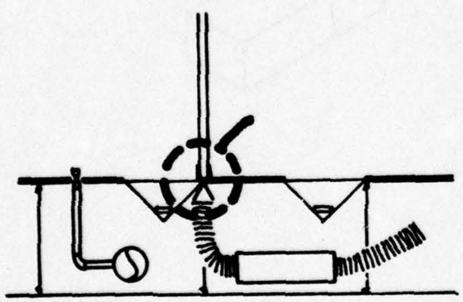
Whenever a module can be utilized, have sheets printed with the modular grid, to assist the designers when laying out the building plan. This will help avoid developing plan configurations which cannot readily be accommodated by the building systems.



Components

Find out what components are available for each subsystem provided, determining what size, shape, color, materials and appearance are available for each component. For example, where a lighting-ceiling subsystem is provided, determine what general configurations are available and how these may be arranged. Determine the requirement for strength and location of supports, and the methods for attaching partitions.



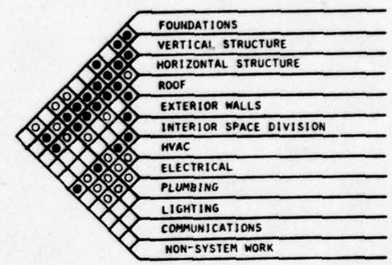


Interface Conditions

The term "interface" is used here to indicate the common boundary, or meeting point, of components. The components may be a part of the same subsystem even though conventionally they would be considered as separate entities in conventional construction, e.g., a lighting-ceiling subsystem.

An understanding of the planning parameters or rules specific to the building systems being utilized will permit the proposer to respond to the interface conditions with a solution based upon optimum utilization of his system. Project design which is based upon a thorough understanding of the system planning parameters will assure greater bidder response, and will prevent cost over-runs.

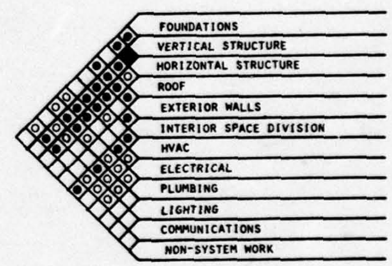
Specific planning parameters are intentionally not included in this guide, except as an example, since they must be based on the requirements of the building systems being utilized for a given project. They will also depend largely upon the number and kinds of subsystems which are furnished, versus those being supplied as non-systems work.



1:345 BUILDING PLANNING PARAMETERS

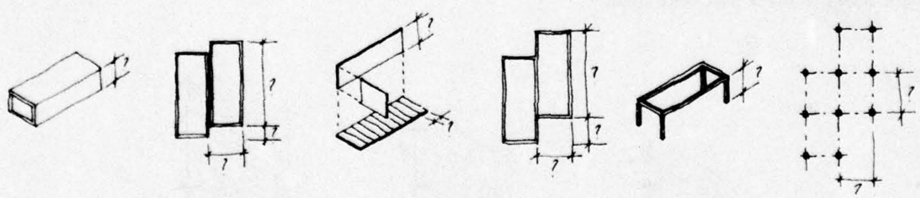
In the margin is a matrix indicating interface conditions which require investigation in order to develop an accurate set of planning parameters. Several of these interface conditions are selected, due to their relative importance, for discussion below. A similar matrix is shown, with each of these sections, indicating the particular interface conditions being discussed.

Horizontal and Vertical Structure

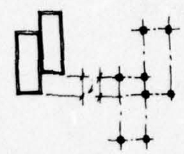


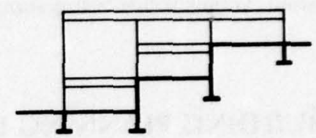
Determine the nature of the interface requirements between vertical and horizontal structural components. Analyze how these may be combined to produce the structure, and whether there is a cost premium for using various planning options which may be available. Then utilize this information in the program requirements.

Determine the "extreme limit" bay size versus the most economical bay size or span capacity. This can be expected to be significantly different for the basic structural types: e.g., volumetric, panel and frame.



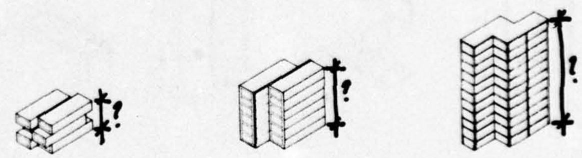
What offsets within the system are permissible, if any; and is there a cost penalty for their use?



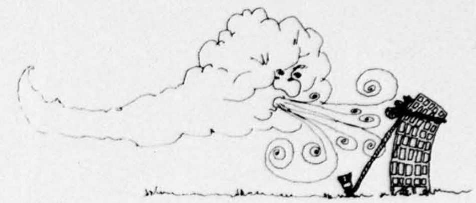


Can non-rectilinear framing be used? If so, how is it accommodated?

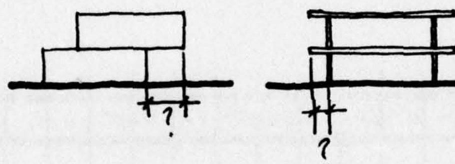
Determine the most economical versus extreme multiple-story limitations. These will vary depending on the type of building systems available. Volumetrics can be expected to have a capacity for one to five stories while panel and frame structures may provide a greater range of from one to ten stories. Pre-engineered metal building structures will generally be limited to a single story with a pitched roof.



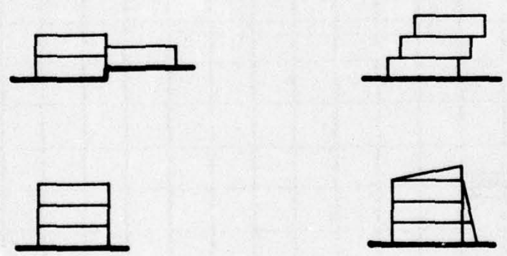
Determine the requirements for wind bracing. Ascertain how the system can accommodate these loads and where and how often this bracing must occur.



Determine if and when cantilevers are permissable for the building structure, and at what cost. The introduction of cantilevers into a system which has no customary provisions for them may cost more than the same cantilever in a conventionally designed building.



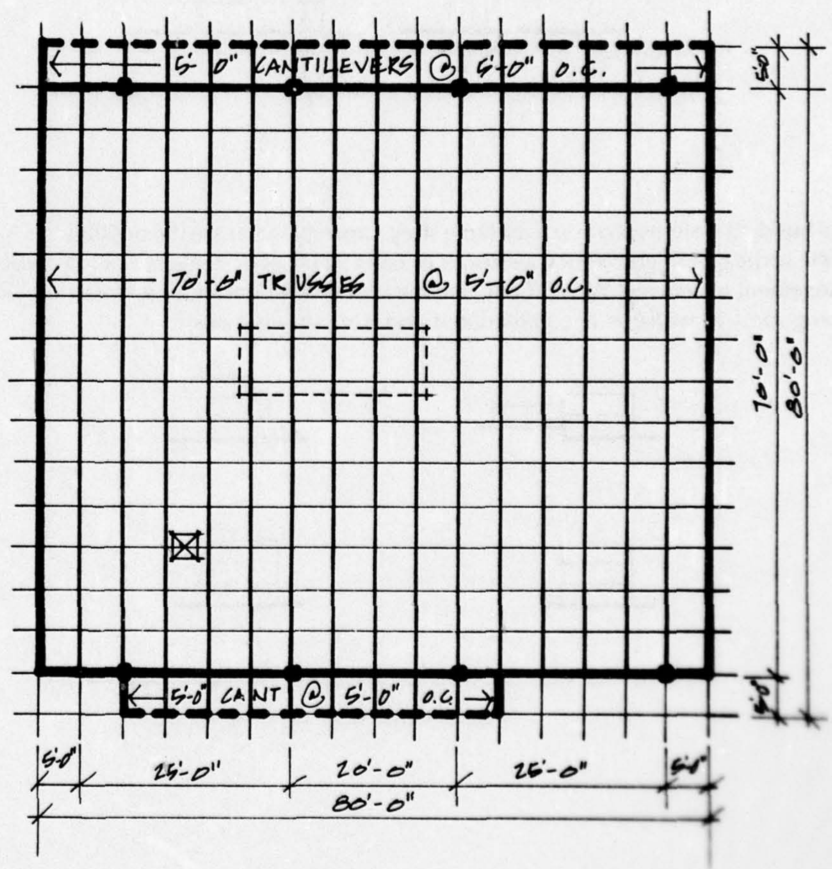
If the building systems provide a multiple story capacity, what are the possibilities for developing the vertical configuration? Can stories or units be offset or staggered or is a regular stacking arrangement necessary? What, if any, are the cost differentials during these possibilities? Can sloping roofs or walls be accommodated and if so, at what cost?



Develop the structural framing plan, using a full set of the structural planning parameters as a basis for making the layout, similar to the examples above:

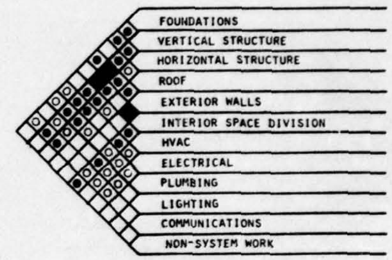
Locate structural elements, in relation to the planning grid, as required for the building systems.

Indicate special structural conditions, such as cantilevers, openings and special loading conditions, if these are required.

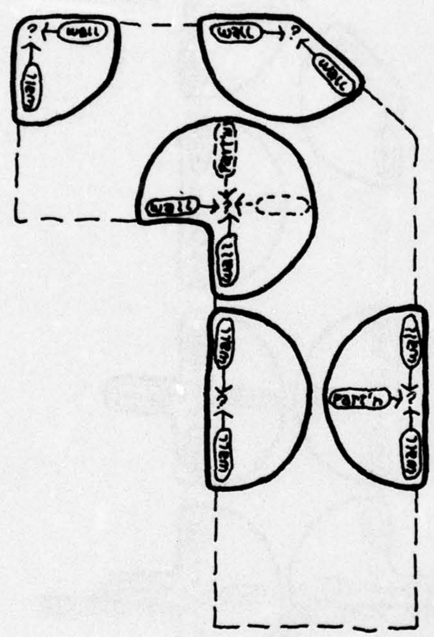


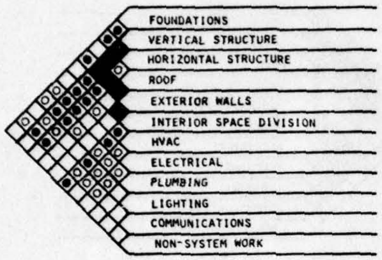
Exterior Walls—Vertical Structure—Interior Space Division

In order to develop an overall building design it is necessary to determine the possible plan configurations which can be accommodated by the exterior wall subsystem, as well as ways in which interior partitions can interface with the exterior wall. For example, determine if an interior partition can be accommodated if it meets a window wall between mullions, or if this causes additional expense.



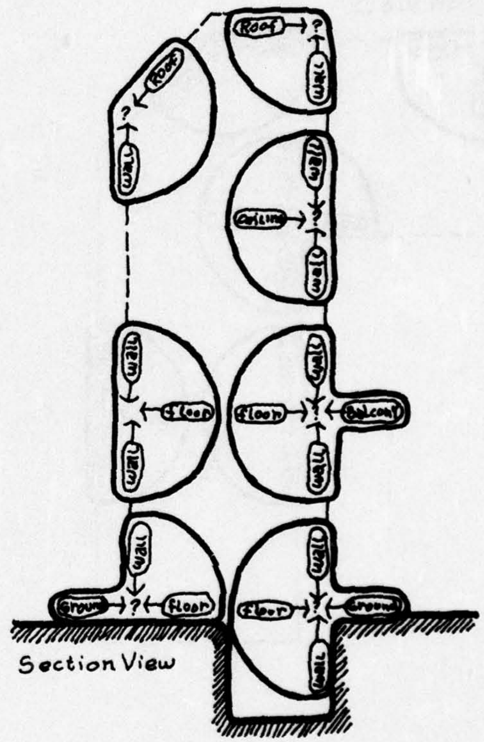
Plan View





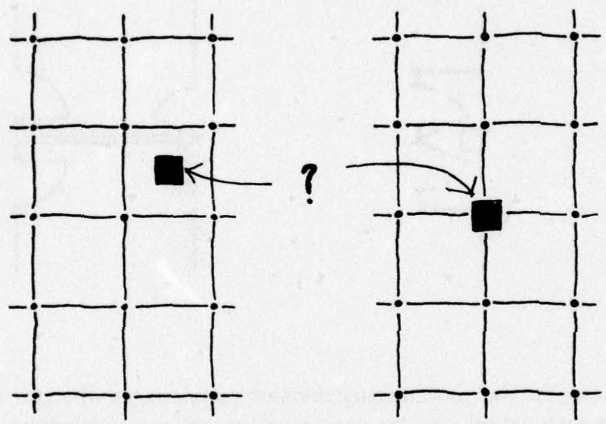
Exterior Walls—Vertical Structure—Horizontal Structure—Roof, Interior Space Division

Determine what planning options are available, and at what cost, for the exterior enclosure. Will the system provide both flat and sloping roofs? Can balconies be used, and if so, with what limitations? If basements are employed, can the exterior wall and structure properly interface with the basement wall? How is the ceiling joined to the exterior wall? An understanding of these interface conditions and the related planning options is necessary in the development of the basic building configuration.

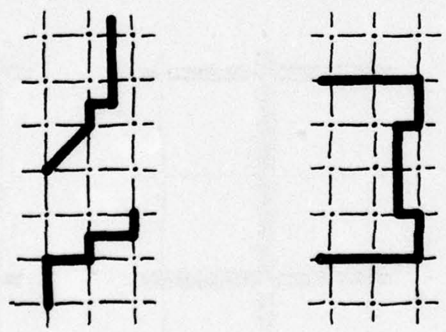


Interior Space Division—Vertical Structure

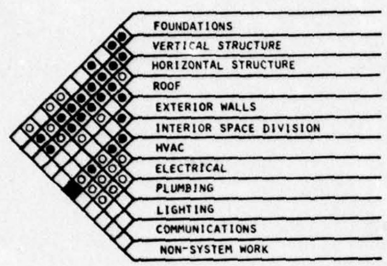
Determine how the interface conditions may affect the planning possibilities which are otherwise available for the layout of the interior space division. Are the ceiling and partitions related to the same planning grid? How does this grid relate to the structural grid?



What are the options for locating partitions with respect to the ceiling grid?

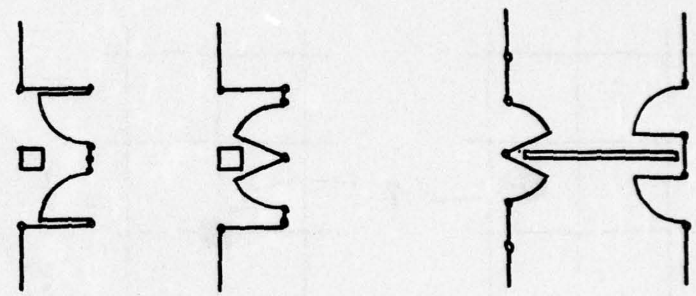


What are the consequences of using these options?

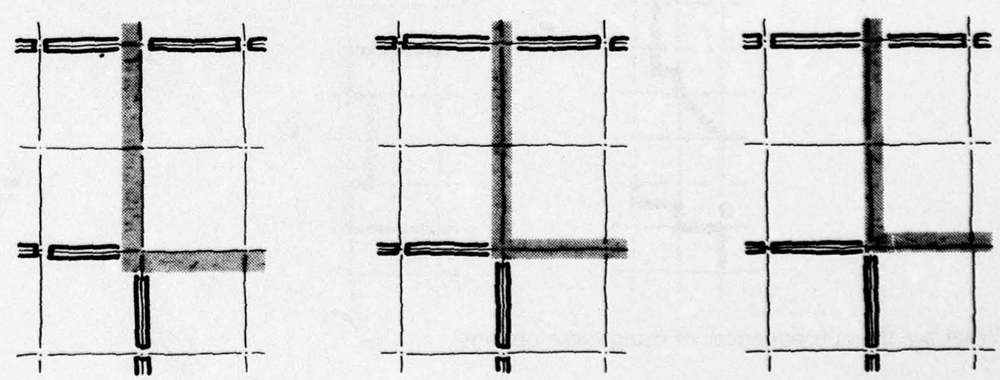


Interior Space Division—Non-Systems Work

What planning techniques should be used to allow the interior space division subsystem to interface properly with non-systems elements?

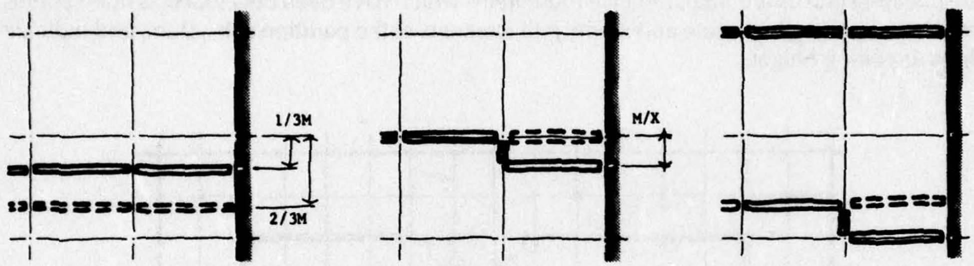


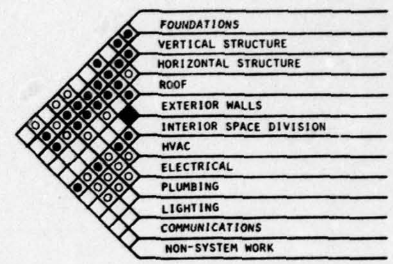
Determine what happens to the interior space division components when the relative location of a non-system element is varied, e.g., the position of the non-system elements. How is closure at a corner best achieved? What plan permits use of the largest number of standard components, as opposed to hand-crafted components? Which positions for non-system elements are most economical and, if flexibility is a requirement, (e.g., demountable partitions), which positions generate the greatest flexibility with respect to equal length and reuse of all panels



Interior Space Division—Exterior Wall

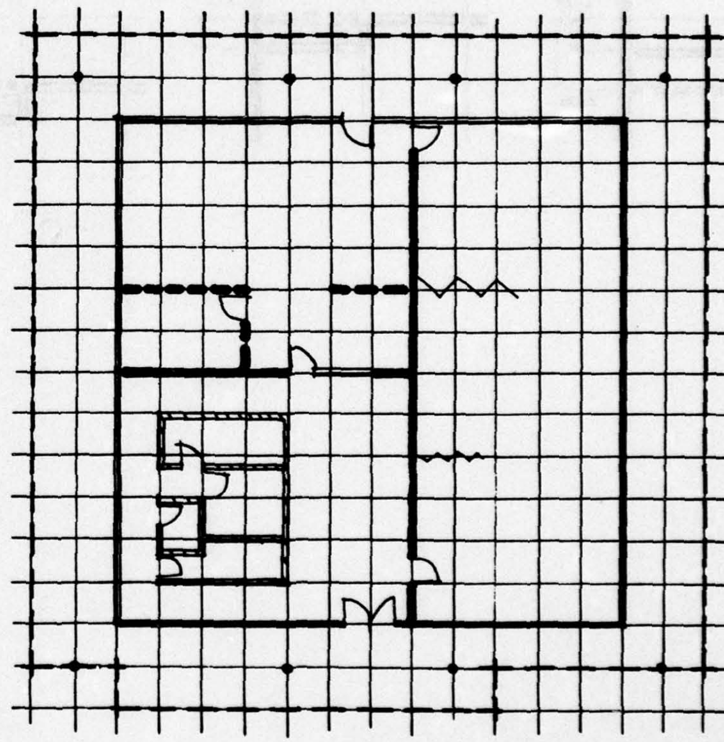
Determine whether the exterior wall is dimensionally compatible with the interior space division module. Will a partition on the module line fall at an easy point of attachment to the exterior wall, *i.e.*, a mullion, or must some other provision be made?





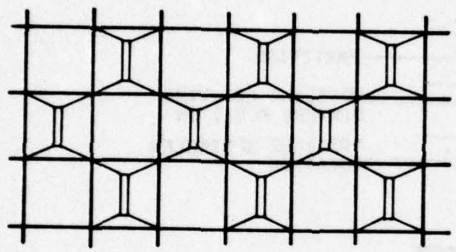
Lay out the *rooms and spaces on the basis of the requirements of the* building program and the *planning parameters of the* interior space division subsystem. Include the considerations for interfacing with other subsystems and non-systems work, as well as the relationship of these elements to the planning grid.

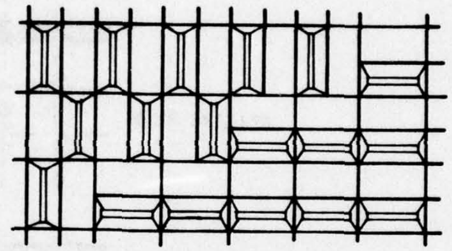
Locate all fixed elements, including columns, fixed partitions and exterior wall. Relate these to the planning grid as required. Indicate those items which have been developed as non-systems work conventionally. Locate and identify all elements of the partition subsystem, and indicate floor to ceiling heights.

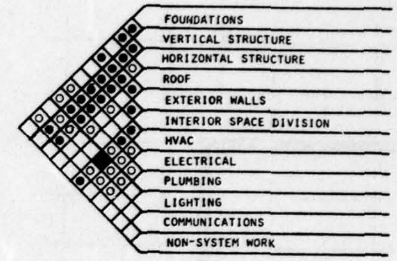


Interior Space Division—Lighting

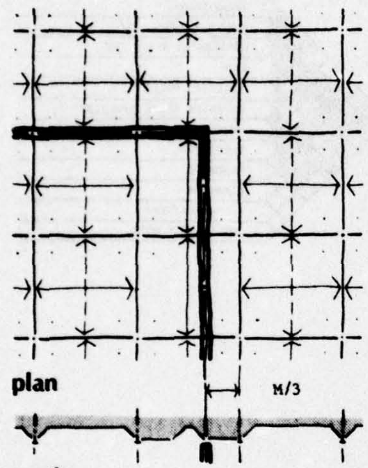
Determine what, if any, provisions should be made to incorporate the lighting with the interior space division subsystem. If a lighting-ceiling is being used, it is necessary to illustrate how the components may be arranged.





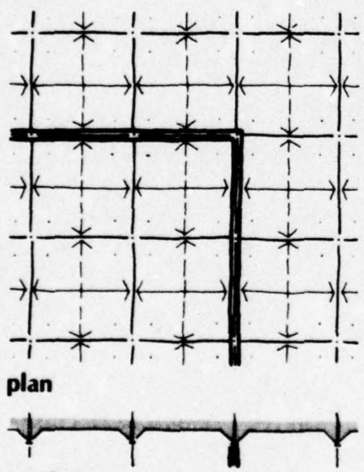


Determine where partitions may be located with respect to the ceiling module, and what effect the placement of a partition will have on adjacent lighting fixtures.



plan

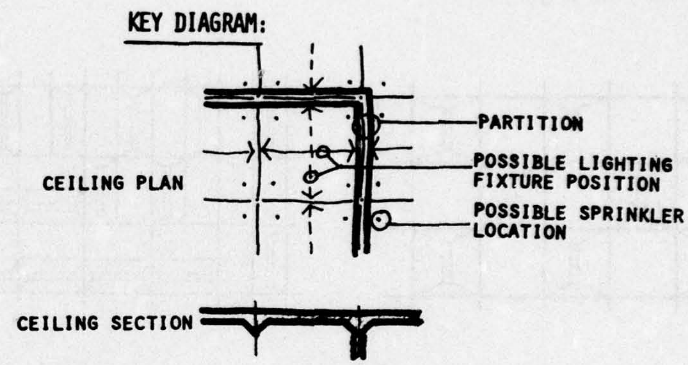
section



plan

section

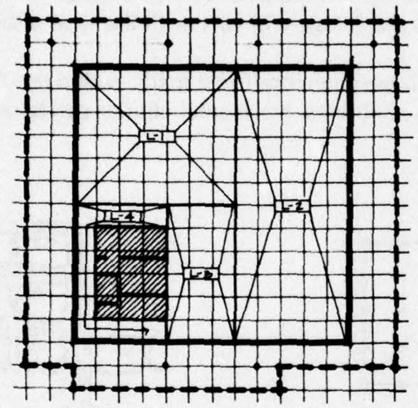
For example, if lighting fixture units are being integrated with the ceiling subsystem, where can partitions be attached? If partitions are attached at the module line, can fixture units run in either direction when adjacent to the partition?



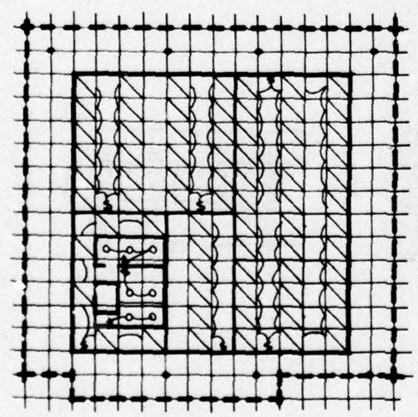
Can a partition be located at the module third point? If so, can a fixture unit be used adjacent to the partition on one side or both sides within the same module? Determine what flexibility is available for relocating fixtures.

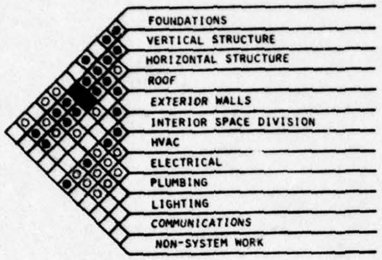
Locate all fixed elements, including columns, fixed partitions and exterior wall.

Define the areas where different kinds of lighting will be utilized, e.g., different lighting levels required, different ceiling pattern or different fixture type.



Develop the distribution system and define the circuitry using traditional design and documentation techniques.

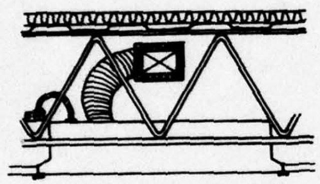


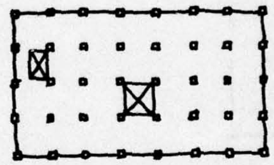


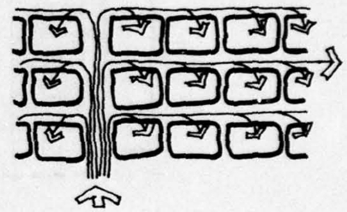
HVAC—Vertical Structure—Horizontal Structure

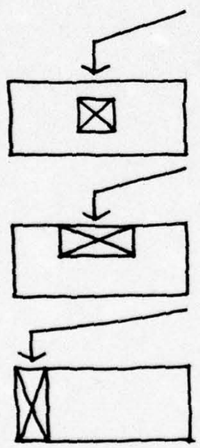
Design and documentation of the mechanical system need not vary significantly from the traditional method, except for the advantage of adequate space having been allocated for duct, pipe and conduit runs. This advantage will vary with the type of building system employed.

A frame system generally allows openings to be made within the limits of the structural unit grid, to accommodate vertical utilities. Horizontal utilities can be accommodated in the ceiling space.

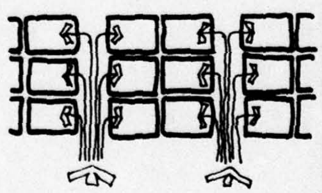


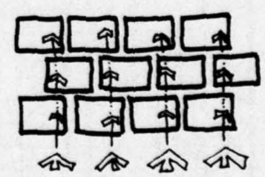


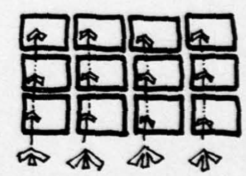




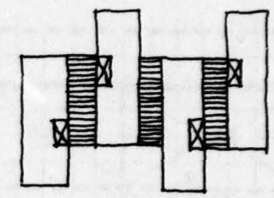
Volumetric systems may have specific requirements for bringing in utility connections, depending on the location and configuration of the utility space. These requirements must be determined before planning has commenced, to avoid redesign or unacceptable design solutions.



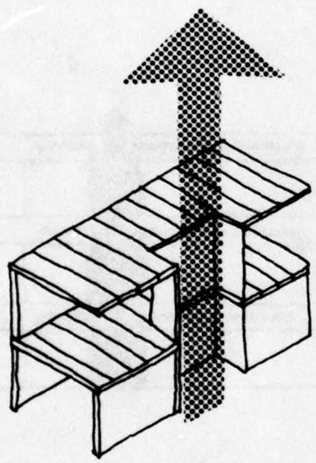


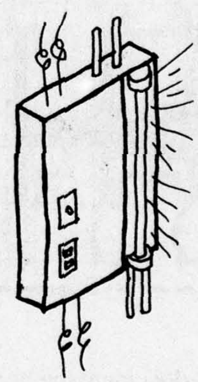


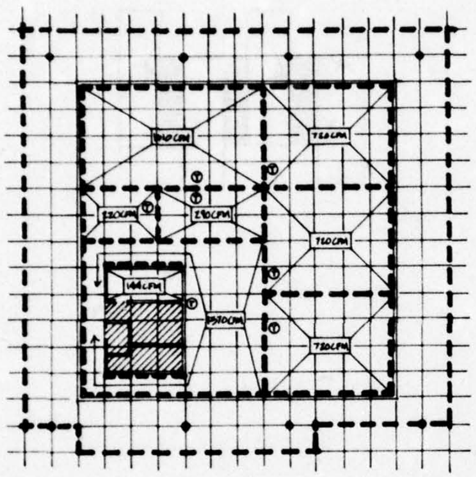
Determine the requirements for vertical utilities when volumetrics are being utilized for multi-story construction. These requirements are likely to be restrictive and may affect the overall building planning. These requirements must be related also to the structural and exterior wall configuration requirements, in order to best accommodate the system when developing the basic building layout.



Panel systems usually allow vertical utilities to run where desired, and most electrical lighting and power sources are contained within the panels. It will still be necessary, however, to determine the compatibility of the building systems being employed to develop the optimum design.







Develop control zones for the HVAC systems, taking into account the previous mechanical planning parameters, the structural frame and the interior space layout:

Locate all fixed elements, including columns, fixed paritions and exterior wall.

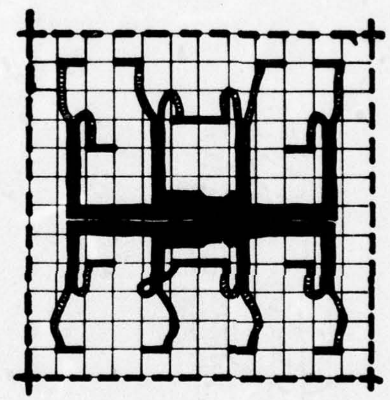
Indicate factors affecting HVAC including U-factors and ceiling heights.

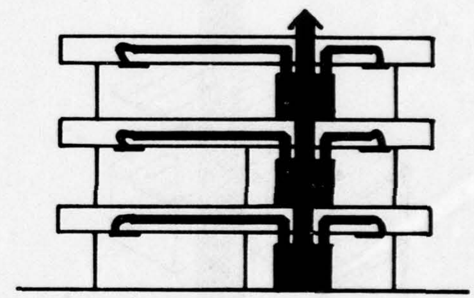
Indicate control zones of remaining areas.

If desired, indicate locations of controls.

Indicate factors affecting HVAC including U-factors, ceiling heights, etc.

Show the CFM requirements for each zone.

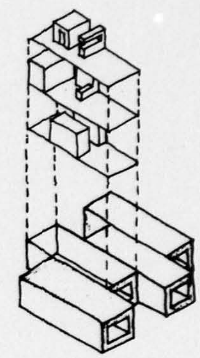




Develop and document the horizontal and vertical HVAC distribution, to accommodate the building system and to fulfill the requirements of the building design program.

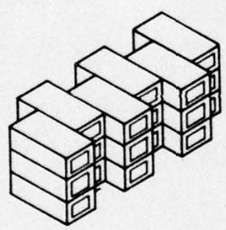
1:346 ALTERNATIVE FIXED DESIGNS

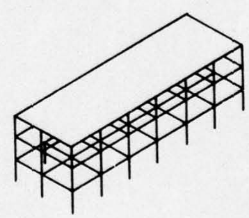
When the planning parameters of the available systems vary significantly, it will be necessary to develop the fixed design in a way which will give each system an equal opportunity to respond, and the accomplishment of this will vary, depending on the degree of difference between the available systems. For example, several volumetric building systems may be capable of producing enclosures which match, but the location of utilities and/or the arrangement of the standard floor plans which they can offer will vary considerably. In this case, develop an alternative layout for each.

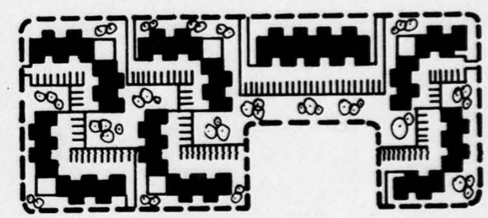


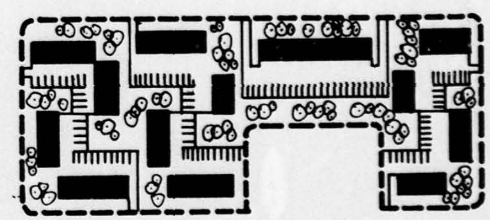
When building system planning parameters vary to such a degree that even the basic rules for designing the structure and exterior enclosures are dissimilar, then it will be necessary to develop a design for each group of building systems which have similar planning parameters. To do this, make a comparison of the characteristics of available building systems (Ref. Subsection 1:305), and then group them into sets in which the major planning parameters are similar, and then proceed to develop a design for each, utilizing the same procedures as has been described for the fixed design strategy. The most critical planning parameters are the structural, exterior, enclosure, interior space division, and the accommodation of mechanical services. ■

(Proceed now to 1:381, *Check List and End Tasks*).









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AN INTERIM GUIDE TO INDUSTRIALIZED BUILDING SYSTEMS.(U)
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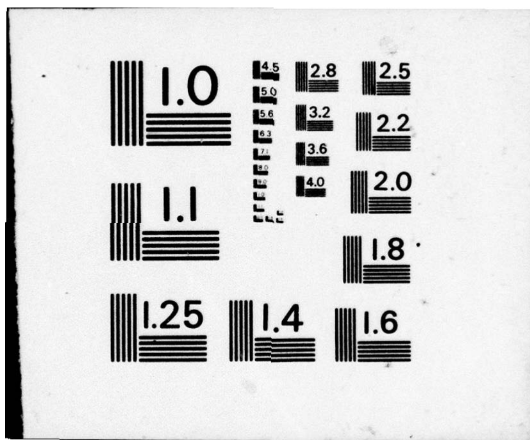
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SECTION FIVE

FOOTPRINT STRATEGY

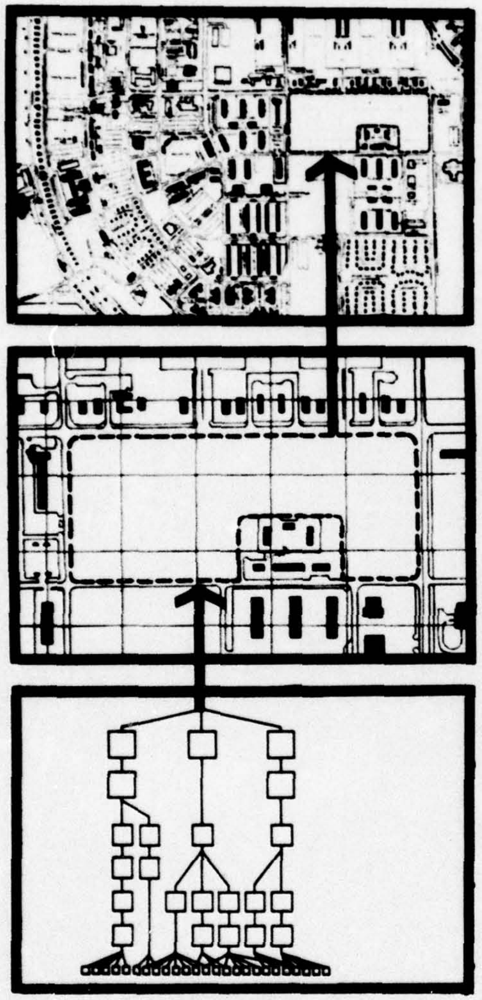
TABLE OF CONTENTS

1:350 GENERAL DESCRIPTION

This section is continued from Section 1:337.

In this phase of the Footprint strategy, design and develop RFP/RFTP plans and specifications for the site and utilities leaving a plot of land within which the proposer will locate the design for his building. The proposals developed in response to the RFP/RFTP will include the building design and all site and utility work within the footprint. Develop RFP/RFTP requirements for the building and footprint which will allow proposers having a variety of systems to respond competatively using the building design most appropriate to their system. This will assure maximum control over the site and utilities while assuring maximum response from a diversity of systems.

Organize the technical section of the specification to conform with the arrangement of requirements presented in this section. The diagram on the following page illustrates this structure. It is an expansion of the diagram first presented in programming and on which the project requirements are based. (Ref. Subsection 1:291). A brief verbal description and illustration of what each set of requirements involves is found on the left.



Project Requirements relate to the entire work to be performed at this time. Such requirements include the context or the existing conditions and master planning considerations which define the desired relationship between existing facilities, the facilities currently being constructed and future facilities.

Site Planning Requirements affect the way in which the buildings may be situated on the site. These will include any special activities or physical characteristics of the site which affect building siting, adjacency requirements of the buildings, circulation of people and vehicles about the site including vehicle parking, and utility access.

Site Subsystems Requirements describe the site work subsystems sufficiently to allow the proposer to develop a proposal.

Building Planning Requirements include adjacency requirements of functional groups, circulation requirements, and any restrictions in building configuration.

Building Subsystems Requirements describe the building subsystems sufficiently to allow the proposer to develop a bid and construct the buildings.

Functional Group Planning Requirements is a set of spaces intended to perform a specific function. Functional group requirements define the function, the relationship of the unit spaces which comprise the group. Example: an administrative suite.

Unit Space Planning Requirements describe the way in which the unit spaces must be structured in order to function appropriately which allowing for a variation of solutions. Unit space represents a typical room or area intended to perform a given function. Example: a bedroom for 1 bachelor officer would be a unit space.

Unit Space Subsystem Requirements describe the items and services which are necessary for a space to function.

Requirement group	Requirement	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
PROJECT REQUIREMENTS	CONTEXT	●			
	MASTER PLAN CONSIDERATIONS	●			
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS		●		
	CIRCULATION - PEOPLE, VEHICLES		●		
	BUILDING ADJACENCY		●		
	UTILITY AVAILABILITY		●		
SITE SUBSYSTEMS REQUIREMENTS	GRADING	●			
	PLANTING	●			
	PAVING	●			
	WATER	●			
	SEWER	●			
	ELECTRICAL	●			
	COMMUNICATIONS	●			
BUILDING PLANNING REQUIREMENTS	ADJACENCY OF FUNCTIONAL GROUPS			●	
	CONFIGURATION			●	
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●		
	VERTICAL + HORIZONTAL STRUCTURE			●	
	VERTICAL TRANSPORTATION			●	
	ROOF			●	
	EXTERIOR WALLS			●	
	INTERIOR SPACE DIVISION			●	
	HVAC		●		
	ELECTRICAL		●		
	PLUMBING		●		
	LIGHTING			●	
	COMMUNICATIONS		●		
FUNCTIONAL GROUP REQUIREMENTS	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	
UNIT SPACE PLANNING REQUIREMENTS	SPATIAL			●	
	FUNCTIONAL DESCRIPTION			●	
UNIT SPACE SUBSYSTEMS REQUIREMENTS	FIXED EQUIPMENT		●		
	MOVABLE FURNISHINGS		●		
	PLUMBING		●		
	HVAC		●		
	LIGHTING			●	
	COMMUNICATIONS /POWER		●		

The diagram on this page indicates the recommended structure of requirements and the best way to express each requirement for this strategy.

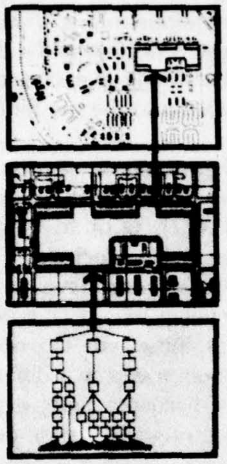
A detailed explanation of how to develop each set of requirements is found on the following pages. A portion of the diagram is found at the beginning of each section keying the explanation to the master diagram.

Read through this entire section and the section on developing a rating system (Ref. Subsection 1:422), prior to commencing work on any part of the technical RFP/RFTP. Then using the program developed earlier, proceed to develop RFP/RFTP requirements and criteria as indicated. Do not hesitate to develop requirements in a different order than they are discussed here, e.g., skip to unit space requirements after developing site requirements, where this proves easier.

1:351 PROJECT REQUIREMENTS

Under this strategy, the proposer will be completing design and layout of the building(s) and the sitework within the building footprint. Project requirements must be developed to establish conditions under which the project will be designed and constructed.

PROJECT REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	CONTEXT	●			
	MASTER PLAN CONSIDERATIONS	●			



Define project requirements which set the context for the erection and intended use of the facility. First, define the type of building, its function and its intended relationship to the adjacent facilities and the installation. This will provide the proposers and their designers with an understanding of the overall project.

Locate the project site and site access routes as would be done conventionally. Review the systems data for any influence on the designation of the transportation routing due to size or weight.

Review systems data to identify any special delivery requirements, including on storage site production facilities or rail sidings. Where such provisions are necessary, state what provisions will be made.

Provide as much information about the project and site as is currently known or available, including such information as:

Existing contours, vegetation, and subsurface conditions.

Existing utilities.

Existing, adjacent structures.

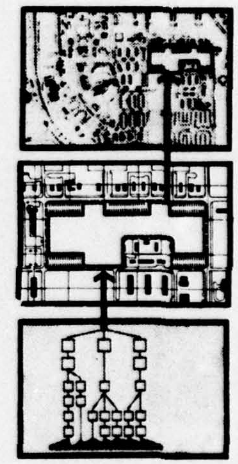
Master planning requirements that will be considered during site design, 5e.g.4, vistas, parking and traffic plan.

1:352 SITE PLANNING REQUIREMENTS

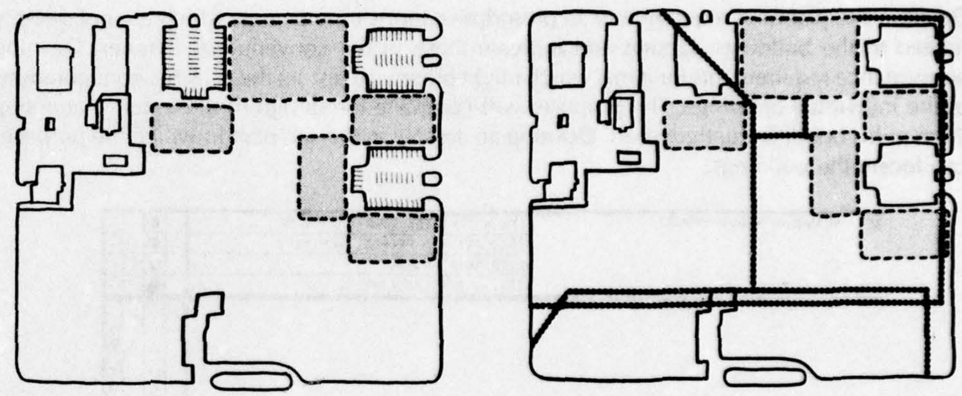
Develop site planning requirements in prescriptive terms for elements which are not directly related to the buildings. Design and indicate these in the conventional manner. Develop performance requirements for items which might otherwise restrict the possible configurations of the individual buildings. The proposer will complete the design of these items, adapting them to his building configuration. Develop an area(s) on the site plan in which the proposer can locate the buildings.

SITE PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SITE ACTIVITIES CONSIDERATIONS		●		
CIRCULATION - PEOPLE, VEHICLES		●		
BUILDING ADJACENCY		●		
UTILITY AVAILABILITY		●		

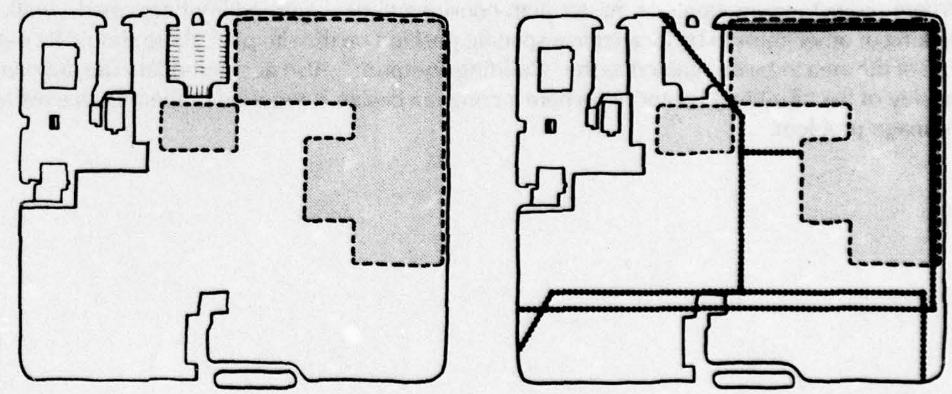
Where project requirements or master plan considerations require utility lines, roads, walks, parking or other items to be located in a specific position on the site plan, these should lie outside of the area to be designated as the "Building Footprint". Also accommodate site drainage outside of the "Building Footprint" where a complex design is required or there is an existing drainage problem.



Use separate footprints for each building where it is known that the available systems are capable of providing a very similar building.



Where a wide variety of building designs are anticipated, for example, one proposer may use six separate buildings to provide the facility while others may use as few as two or three, designate to the building footprint an area large enough to accommodate these solutions.



Weigh these conditions as they apply to the project at hand when determining the size, shape, and location of the Building Footprint.

Site Activities Considerations

Determine all items which must be located on the site, and all activities which are anticipated. Define, in prescriptive terms, those activities which are to be located on the site plan, versus those which are to be located within the building footprint by the proposer, including items such as on site parking, service courts or storage areas site maintenance, including snow removal for the design of walkways, ramps, steps, site lighting fixtures, grade changes, etc. Describe other special activities and the provisions required; for example, if the project includes a headquarters building and "flag raising" or other ceremonies are anticipated, to occur within the building footprint, describe these in adequate detail to allow the proposer to accommodate these activities in his layout.

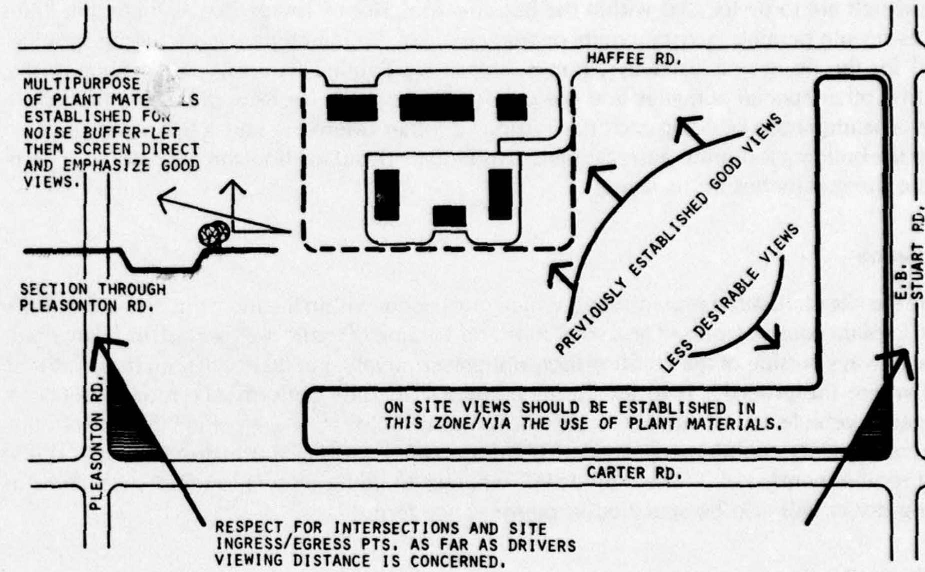
Circulation

Define the site circulation requirements which must occur within the footprint, in performance terms. Explain what is required and what type and volume of traffic is expected. Indicate roads and walkways outside of the building footprint prescriptively, but do not extend these into the areas where the proposer is to locate his buildings. Include performance requirements for emergency vehicle access into or through the building footprint. Make certain that site circulation requirements complement those of building planning, Ref. Subsection 1:354, and unit space requirements, Ref. Subsection 1:357 wherein building circulation and such items as loading docks will also be specified in performance terms.

Building Adjacency

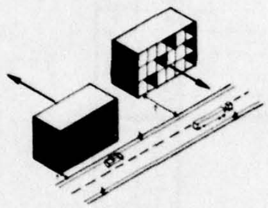
Since the buildings, and that part of the site within the building footprint, are being designed by the proposer, it is necessary to develop a guideline to direct the proposer in siting the buildings in accordance with the program requirements. When the building footprint allows only for the location of one building, building adjacency is then largely defined in relation to the various other footprints; but when several buildings are anticipated within the footprint, these adjacency requirements must then be defined in performance terms. In developing building adjacency guidelines, include the following:

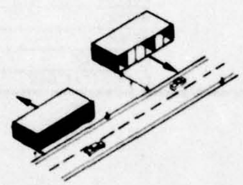
Visual Considerations: Direct this concern to the environmental conditions of the site including "good view-bad view" considerations.

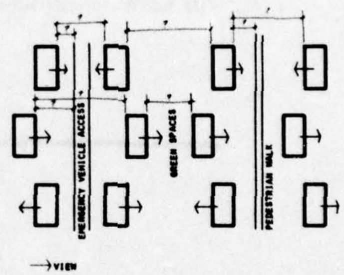


Functional Considerations: Indicate the relationship of buildings to parking to existing facilities, and to overall master plan requirements.

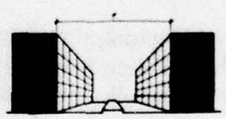
Distance Relationships: Define desired maximum/minimum distance relationships between buildings, related to story height, emergency vehicle access, distance required for a walkway between buildings, distance between ends of buildings; between end and front, end and back, back to back, front to front, back to front, etc. Consider how building height and direction of view needs to affect the proximity of the building to main road, and whether the introduction of planting used as a screen will affect this distance.

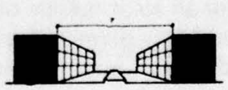






Also consider the effects of building height and direction upon the location of the pedestrian walks and green spaces.





Utility Distribution

Indicate utility lines including sizes and capacities up to the building footprint. Do not attempt to anticipate the distribution of utilities within the footprint. The proposer will complete the utility layout to best serve the design being submitted.

1:353 SITE SUBSYSTEM REQUIREMENTS

Site subsystem materials may be specified prescriptively without unduly restricting the proposer's possible plan configuration; however, the location of these subsystems must be specified in performance terms when they occur within the building footprint. The location of site subsystems is indicated prescriptively in all site areas outside of the building footprint.

SITE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
GRADING	●			
PLANTING	●			
PAVING	●			
WATER	●			
SEWER	●			
ELECTRICAL	●			
COMMUNICATIONS	●			

Grading

Establish finsh grades for all areas outside of the building footprint, and specify the degree of deviation from these which is permitted within the building footprint. Define the methods of backfilling and grading as would be done conventionally, and where possible indicate sources of backfill material.

Planting

Depending on the way in which the siting requirements are developed, the amount of planting within the building footprint may vary with different layouts. Variation will occur where planting is utilized for screening purposes within the building footprint, Ref. Subsection 1:342. Outside of the building footprint, all planting should be specified in prescriptive terms. It will be necessary, however, to specify minimum quantities of trees and shrubs for location within the footprint as well as sodding and seeding requirements. Make several combinations of acceptable quantities which are approximately equal in cost, 5i.e.4, one with more trees and fewer shrubs, one with more shrubs and fewer trees and one with an equal mixture. This will allow the various proposers to utilize the combination which best adapts to their particular layout.

Specify the type of plants required and the manner of installation in prescriptive terms, since this will not restrict the proposer's design.

Paving

Specify all paving types required and the method of construction in prescriptive terms. Indicate all paving areas outside of the building footprint, leaving the area within for completion by the proposer. The requirements for locating paving within the footprint are described under circulation requirements, Ref. Subsection 1:352 (circulation). Make it clear to the proposer what type of paving should be used for each type of circulation which he must accommodate within the building footprint.

Water and Sewer

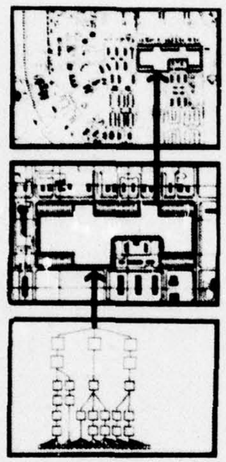
Provide a complete drainage plan for the site area which lies outside the building footprint: When the footprint(s) are relatively small, require the proposer to develop the grading within the footprint in a manner which will bring site run-off to drains located outside the footprint. Where the footprint is relatively large, in anticipation of several buildings being located within, bring storm sewer lines up to the footprint and develop performance requirements for the design of the remaining portion. Carry all other water and sewer lines up to the building footprint, for completion by the proposer. Specify the materials and methods desired in prescriptive terms, but sizing to be established by the proposer within the footprint, where he is providing the design.

Electrical and Communications

Indicate prescriptively the means by which both permanent and temporary power will be supplied. Define the products and installation methods to be used for both electrical and communications. Develop the layout for these in the areas outside of the building footprint, leaving completion of the area within to the proposer. It will be necessary, however, to establish a guideline for the footprint area layout which the proposer is to complete; to do this, indicate lighting levels and communication requirements for the various site activities within the footprint. Give lighting levels required for parking lots, pedestrian walks and street lighting, which occur within the footprint. The number and location of the fixtures will be dependent upon the layout provided by the proposer in conformance with the lighting levels specified.

1:354 BUILDING PLANNING REQUIREMENTS

Express requirements which will determine the building layout in performance terms, to allow for the widest range of accessible solutions.



BUILDING PLANNING REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	ADJACENCY OF FUNCTIONAL GROUPS			●	
	CONFIGURATION			●	

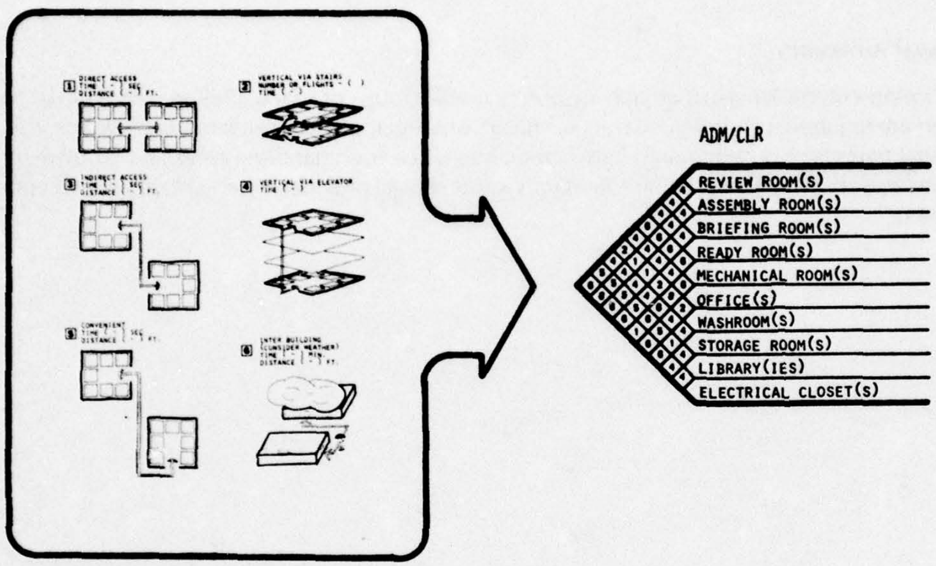
This will give the proposer the clearest understanding of the user's needs, while still permitting the proposer to incorporate these needs within the capabilities of his building system.

Adjacency of Functional Groups

Define each major grouping of spaces, and how these groups must relate to each other. (See 1:356). This will guide the proposer in arranging these major groupings, and help assure that the layouts will satisfy the user's needs. Express these adjacency requirements in terms of circulation, vision and sound, using the following considerations as a guide.

Circulation

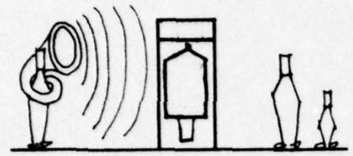
Define adjacency of functional groups by developing optimum criteria for travel distance and and time between functional groups of spaces, to demonstrate which groups must relate most closely with other groups. (See figure 271).

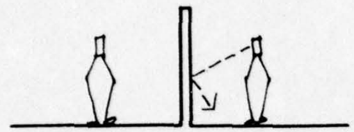


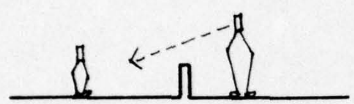
Require the proposer to accommodate the maximum number of peoplewhich it is anticipated will move from one functional group to another during peak traffic periods. Define the frequency and size of portable equipment required moved between functional groups of spaces. This will affect the connecting corridor, lobby, door types and sizes.

Define exit criteria by means of reference standards, codes of interpretation thereof, to facilitate proposer understanding and proposal evaluation.

Develop criteria for limiting access to functional groups when applicable. Security areas are one frequent need; storage and maintenance areas as well as private quarters may also require limited accessibility.







Acoustical Adjacency

Establishing criteria for acoustical separation of functional groups of spaces when this is devised. For example, inform the proposer that key punch and machine rooms must not be acoustically adjacent to quiet office areas, but allow the proposer and designer to solve this either through construction methods or isolated location.

Visual Adjacency

Develop criteria for visual adjacency of functional groups of space. Define where visual barriers are required, or where visual access must be maintained between functional groups, e.g., visual barriers may be required between maintenance-trash handling areas and lobby/recreation areas, but main circulation routes for visitors should provide visual contact with reception areas.

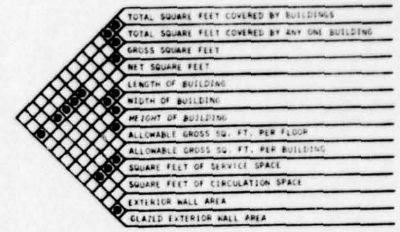
Configuration

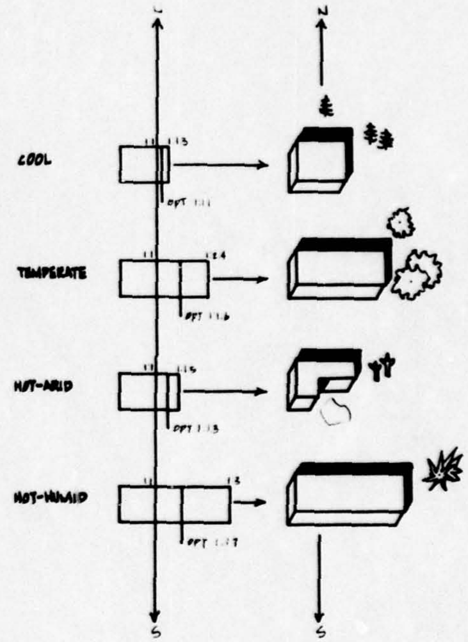
Establish performance criteria to govern the configuration of the building, still permitting the widest latitude of design solutions. These will assist the proposers, during design, as a guide in developing user-acceptable solutions.

Establish dimensional and area relationships only when applicable, *e.g.*, the acceptable ratio of circulation and service area to gross square feet; or building coverage to site size. See the marginal illustration for other examples.

Base configuration criteria upon master plan considerations, specific environmental conditions and aesthetics. For example, the environmental conditions may have a valid effect upon length-to-width-to-height relationships. If the climate is cold it is more efficient to heat a building with a 1L:1W ratio; or, if the climate is predominantely hot and humid, a building is more efficiently cooled if it has a ratio 1.7L:1W. On the other hand, a building in hot and dry climate is more efficiently cooled when it is planned in such a way that it produces part of its own shade, *i.e.*, suggesting the use of court yards. Weigh such requirements against aesthetic and master plan configurations, and then establish an acceptable range of requirements.

Dictate specific heights or number of stories only when absolutely necessary. Give a range of stories, or massing desired of major elements, if possible.





1:355 BUILDING SUBSYSTEM REQUIREMENTS

Establish building subsystem requirements as indicated in the diagram below. The general content of each subsystem is defined below, with directions for the type of criteria to be expressed prescriptively versus the type of criteria to be described in performance terms. References are given to the standards and sources when appropriate.

BUILDING SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FOUNDATIONS		●		
VERTICAL + HORIZONTAL STRUCTURE			●	
VERTICAL TRANSPORTATION			●	
ROOF			●	
EXTERIOR WALLS			●	
INTERIOR SPACE DIVISION			●	
HVAC		●		
ELECTRICAL		●		
PLUMBING		●		
LIGHTING			●	
COMMUNICATIONS		●		

Foundations

Specify foundations in prescriptive and performance terms. Define prescriptively such requirements as:

Minimum depth below grade.

Concrete standards for materials and methods.

This type of prescriptive requirement is based upon accepted engineering solutions. The state of the art of foundation subsystem development and use is not such that prescriptive requirements will inhibit the proposers.

Provide values for such performance terms as:

Allowable bearing pressures.

Resistance to forces

Interface with structure.

Water resistance for basements.

These requirements can readily be specified in performance terms.

Avoid requirements for specific types of foundations, such as continuous footings, piles, grade beams, etc., which can inhibit a proposer and result in adverse costs.

Vertical and Horizontal Structure

Develop performance requirements for the structural subsystems. Since materials and components will vary considerably from one system to another, definition of requirements in perscriptive terms will inhibit a proposer and result in adverse costs.

Include performance requirements for columns and bearing walls, and floor and roof structure; also include performance requirements for slabs on grade.

Structural subsystem performance requirements have been developed for numerous, existing systems projects (Ref. Subsection 1:303). Use these sources, in conjunction with a comparison of feasible systems versus project requirements, (Ref. Subsection 1:304).

Roof

Establish performance requirements for the roof subsystem. The materials and methods used for these subsystems will vary considerably among system proposers. New single-ply membranes are presently in competition with a wide variety of bituminous roofing assemblies, and in some cases with metal roofing. Insulation types and substrates vary widely. Therefore, use performance criteria to define what is required of this subsystem.

Review "Information Sources on *performance* specification", (Ref. Subsection 1:303) for examples of such requirements. Requirements for bonded roofs may be included in accordance with local availability or customary user performance, taking into account that industry's responsibility for stringent bonds and guarantees is in a state of transition. Give specific consideration to requiring weathering certification tests, positive drainage, fire, wind uplift and thermal resistance. Requirements for resistance to wear due to rooftop equipment will depend upon the use of such equipment at the project.

Exterior Walls

A wide variety of construction and materials will be used in this subsystem. Define requirements for exterior walls in performance terms only. Describing requirements *prescriptively* for this subsystem will inhibit proposer response. Include windows and doors in this section; do not include structural bearing requirements, which are included under structural.

If the project is a storage type facility, most or all of the available systems may have exterior walls constructed of the same or similar materials, *e.g.*, pre-engineered metal buildings. When this is the case, define the requirements in prescriptive and *performance terms. For example*, establish prescriptive requirements *for thicknesses* and type of materials, but define finishes, thermal resistance and weather resistance in performance terms.

It should be noted that there has *been little* success in defining positive aesthetic requirements for this subsystem without adverse limitations of proposer response. See "Information Sources on Performance Specification," Subsection 1:303, page for examples of criteria which has been developed *for other recent projects*.

Interior Space Division

Utilize performance terms in defining this subsystem, since prescriptive requirements would inhibit the proposer. The construction and materials used in this subsystem will vary widely among systems, especially in closed systems adaptive to housing and storage type facilities. *Performance* requirements for this subsystem have been developed for several projects, (Ref. 1:303).

The sample specification in the appendix, 2:320, should be used as a typical format for the requirements for this subsystem.

HVAC

Develop prescriptive and *performance requirements* for this subsystem. Most requirements can readily be expressed in performance terms. but options required for specific building-use functions, or for sophisticated environmental controls are best specified in prescriptive terms.

Establish overall requirements for the HVAC system in performance terms, using recognized reference standards. When several types of subsystems will be *proposed*, establish parallel sets of requirements, e.g., unitary air subsystem requirements will differ from central hydronic, but either may be acceptable, subject to conformance with the specified requirements.

Define requirements for optional features required of all subsystems in prescriptive terms, e.g., filter requirements, the degree of automation for controls, etc.

The time span for performance by this subsystem is difficult to specify, and even more difficult to verify during operation. For this reason, many systems programs have relied upon renewable maintenance contract, included with the proposer's bid, to assure the maintenance of quality of performance over a specified period of time. When the project permits, it is recommended that provisions for such contract be included.

Electrical

Establish requirements for the electrical subsystem in prescriptive and performance terms. In the private sector this subsystem is highly-regulated by codes and authorities; much of such regulation is highly-prescriptive and has remained unchanged by "systems" pressures. Incorporate these standards by reference or inclusion as would be done for a conventional project. See "Information Sources," 1:303.

Define requirements for the overall electrical system in performance terms. Incorporation of this subsystem into each system will vary with the nature of the subsystems with which it must interface, e.g., differently in a system with concrete walls and partitions than with a system with frame walls.

Plumbing

Define this subsystem using prescriptive and performance requirements. Use performance requirements to define criteria reflecting accepted engineering practice, such as:

Noise criteria

Structural support

Fixture quantities

Use performance requirements when they presently occur in applicable codes or standards.

Define requirements prescriptively when it is desirable to define the quality of the materials, e.g., where galvanized iron pipe is acceptable. Define requirements prescriptively when acceptable codes and standards are also inherently prescriptive, such as for traps and vents. Refer to "Information Sources" for examples of this on other projects. (Ref. 1:303).

Identify fixtures prescriptively, using generic terms for fixture type, e.g., siphon jet, elongated bowl, flush valve type.

Specify lavatories and sinks by receptacle size rather than specific type; define fittings preciptively. See unit space subsystems, 1:357, for requirements for fixtures and utilities in relationship to unit spaces.

Lighting

Develop requirements for this subsystem in performance terms only. Lighting fixtures and solutions vary widely among systems and prescriptive requirements will inhibit the response of many proposers.

The scope and nature of the required lighting subsystem will depend upon the building type and project requirements; in some instances it will be advisable to combine other subsystems with lighting, to form a composite subsystem, *i.e.*, a lighting/ceiling subsystem.

Lighting performance requirements have been developed on many previous systems projects. Use these sources to develop appropriate criteria. (Ref. 1:303).

Communications

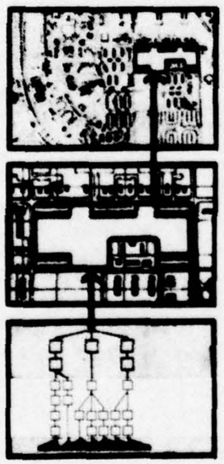
Define requirements for this subsystem in prescriptive and performance terms, including telephone, intercom, alarm, clock, and television to the extent that they are required.

Define requirements for complex equipment and for equipment which must interface with existing communication lines in prescriptive terms. Compare such installation requirements with available building systems, to determine if problems may occur.

Establish performance requirements for the subsystem layout, to permit the proposer to integrate this subsystem with his design without restriction. Where the junction of the equipment can be readily expressed in performance terms, performance specifications should be established; if not, use prescriptive specifications.

1:356 FUNCTIONAL GROUP REQUIREMENTS

Define functional group requirements in performance terms to allow the proposer the flexibility of a wide range of solutions to the building design requirements. Functional group is the term for a combination of unit spaces or a combination of smaller functional groups, which are required to be designed together. For example, an apartment represents a functional group, composed of unit spaces such as sleeping spaces, living space, dining space, kitchen space, bathroom space and storage space. A functional group of a higher order is a given mix of apartments, including laundry and recreational facilities. Define functional group requirements, to establish the relationships which will guide the proposer during the development of building design.



FUNCTIONAL GROUP REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	

Task Performance Considerations

List those items which are considered important to help define the functional groups. These items will serve as a guideline for the proposer as he arranges the functional groups within the building being submitted, and can also be used during proposal evaluation to determine how well the proposer responded to each requirement, to be utilized later as part of the rating system for proposal evaluation See Subsection 1:422 for a more detailed explanation of the rating system.

When compiling a list of task performance considerations, first decide the nature of the task which the functional group is intended to serve. Then include a brief description of the task as a part of the presentation of the requirement. Next, make a list of activities which will be performed with the functional group, and indicate for each the relative importance of the design consideration.

Quantity — Adjacency of Unit Spaces

Indicate the number and type of unit spaces which will make up each functional group. Also define the adjacency requirements, which will guide the proposer in arranging the unit spaces into functional groups and floor plans. The considerations previously described under Building Planning Requirements for adjacency of functional groups also apply to adjacency of unit spaces. (Ref. Subsection 1:354.)

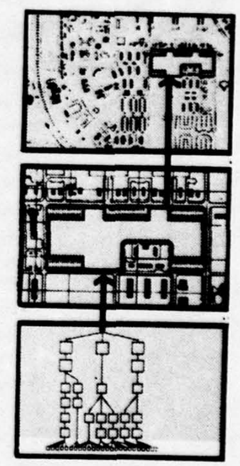
1:357 UNIT SPACE PLANNING REQUIREMENTS

A unit space is usually characterized as a room, although it may also be an open or semi-open area serving a specific purpose, e.g., one end of a lobby serving as a reception area. Define the spatial and functional requirements for unit spaces in performance terms. This will allow variation of the dimensions and configurations which most proposers will have within their individual building systems. It will also allow for the variety of relationships among unit spaces, which will likely occur when these unit spaces are combined into various functional groups.

UNIT SPACE PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SPATIAL			●	
FUNCTIONAL DESCRIPTION			●	

Spatial

Define the maximum and minimum acceptable requirements for floor area and ceiling height for each unit space.



Functional Description

Describe the activities which the unit space will be expected to accommodate. In addition to their activities, list the numerical range of persons who will use the space. Indicate this range on three levels:

MINIMUM: The smallest number remaining for any reasonable length of time.

NORMAL: During an average day, the greatest number of users anticipated at the same time; (this number should be accommodated with the greatest comfort).

MAXIMUM: The highest number to be provided for at the same time (not necessarily at maximum comfort).

1:358 UNIT SPACE SUBSYSTEM REQUIREMENTS

Establish prescriptive and performance requirements for each unit space subsystem, to define how the subsystems relate to each space and to provide a further guide to how the spaces are used. The subsystems to be described in prescriptive terms versus performance terms are given below.

UNIT SPACE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FIXED EQUIPMENT		●		
MOVABLE FURNISHINGS		●		
PLUMBING		●		
HVAC		●		
LIGHTING			●	
COMMUNICATIONS /POWER		●		

Identify all pieces of fixed equipment which must be accommodated and whether included with a proposal or by others. Give dimensions if they cannot vary; otherwise indicate the range of probable dimensions. Define all required service connections in prescriptive terms. Material can be specified in detail with restricting the proposer's ability to develop the unit space within the capabilities of his system.

Movable Furnishings

Identify all movable furnishings which must accommodate and their intended function. Give dimensions of furnishings which will not vary; otherwise indicate the range of probable dimensions.

HVAC

Define the acceptable ranges of temperature, humidity, ventilation, and exhaust requirements. Note controls required.

Lighting

Indicate quality and quantity of light required for the space, and control requirements for the lighting; do not indicate type or location of fixtures. Note controls for other unit spaces, or controls for this unit space which are located elsewhere.

Communications/Power

Define communication and power requirements and their function in this space, except where previously noted for equipment service connection. Express location requirements in performance terms.

This concludes the section concerned with preparation of the RFP/RFTP. Continue with the section Proposal and Evaluation, 1:400.

SECTION SIX

SEQUENTIAL STRATEGY

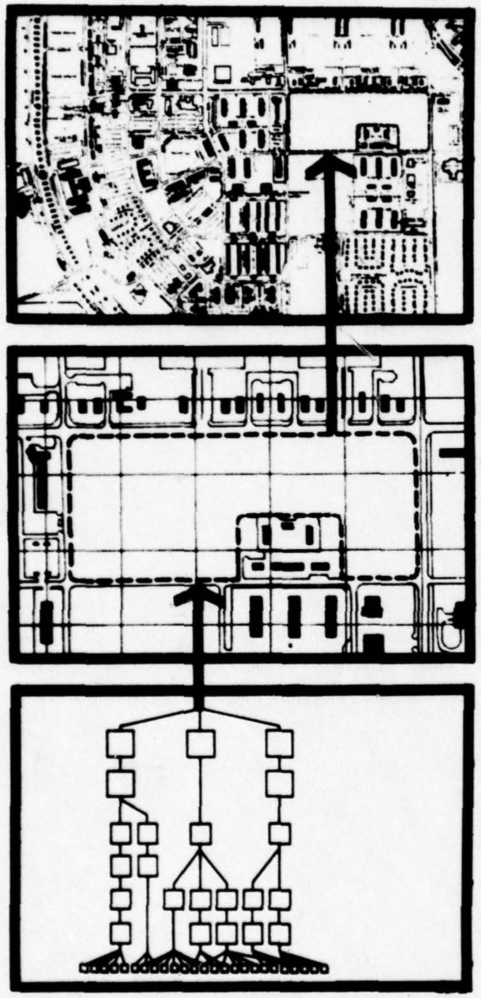
TABLE OF CONTENTS

1:360 GENERAL DESCRIPTION: SEQUENTIAL STRATEGY

This section is continued from section 1:338.

The RFP/RFTP specifications developed during this phase allow the proposers having systems which may vary significantly to respond competitively. The proposals developed in response to the RFP/RFTP will include a design for the building which utilizes the building system being offered. After selection of the most acceptable building proposal, develop a second RFP for the sitework. The layout of the sitework will be done conventionally and will accommodate the selected building design. Thus, the Sequential Strategy process will assure control of the relationship of the building(s) to the site and adjacent facilities.

Organize the technical sections of the specifications to conform with the structure of requirements as described in this section.



Project Requirements relate to the entire work to be performed at this time. Such requirements include the context or the existing conditions and master planning considerations which define the desired relationship between existing facilities, the facilities currently being constructed and future facilities.

Site Planning Requirements affect the way in which the buildings may be situated on the site. These will include any special activities or physical characteristics of the site which affect building siting, adjacency requirements of the buildings, circulation of people and vehicles about the site including vehicle parking, and utility access.

Site Subsystems Requirements describe the site work subsystems sufficiently to allow the proposer to develop a proposal.

Building Planning Requirements include adjacency requirements of functional groups, circulation requirements, and any restrictions in building configuration.

Building Subsystems Requirements describe the building subsystems sufficiently to allow the proposer to develop a bid and construct the buildings.

Functional Group Planning Requirements is a set of spaces intended to perform a specific function. Functional group requirements define the function, the relationship of the unit spaces which comprise the group. Example: an administrative suite.

Unit Space Planning Requirements describe the way in which the unit spaces must be structured in order to function appropriately which allowing for a variation of solutions. Unit space represents a typical room or area intended to perform a given function. Example: a bedroom for 1 bachelor officer would be a unit space.

Unit Space Subsystem Requirements describe the items and services which are necessary for a space to function.

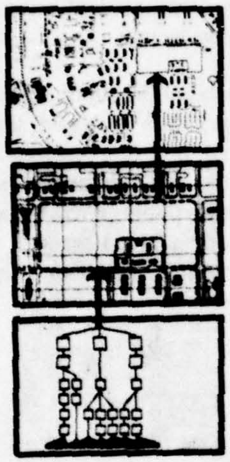
Requirements		Prescriptive	Presc/Performance	Performance	Not in System Contract
PROJECT REQUIREMENTS	**CONTEXT**	●			
	MASTER PLAN CONSIDERATIONS		◐		◐
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS				●
	CIRCULATION - PEOPLE, VEHICLES				●
	BUILDING ADJACENCY				●
	UTILITY AVAILABILITY				●
SITE SUBSYSTEMS REQUIREMENTS	GRADING				●
	PLANTING				●
	PAVING				●
	WATER				●
	SEWER				●
	ELECTRICAL				●
	COMMUNICATIONS				●
BUILDING PLANNING REQUIREMENTS	ADJACENCY OF FUNCTIONAL GROUPS			●	
	CONFIGURATION			●	
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●		
	VERTICAL + HORIZONTAL STRUCTURE			●	
	VERTICAL TRANSPORTATION			●	
	ROOF			●	
	EXTERIOR WALLS			●	
	INTERIOR SPACE DIVISION			●	
	HVAC		●		
	ELECTRICAL		●		
	PLUMBING		●		
	LIGHTING			●	
	COMMUNICATIONS		●		
FUNCTIONAL GROUP REQUIREMENTS	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	
UNIT SPACE PLANNING REQUIREMENTS	SPATIAL			●	
	FUNCTIONAL DESCRIPTION			●	
UNIT SPACE SUBSYSTEMS REQUIREMENTS	FIXED EQUIPMENT		●		
	MOVABLE FURNISHINGS		●		
	PLUMBING		●		
	HVAC		●		
	LIGHTING			●	
	COMMUNICATIONS **/POWER**		●		

The diagram on this page illustrates the structure of requirements, and is an expansion of a diagram first presented in Programming. (Ref. 1:291). A brief description of each set of requirements is located at the left of the key diagram. The requirements listed to the right of the key diagram identify the appropriate specification to use.

Read through this entire section prior to commencing work, then proceed similarly to a conventional building project. Develop the requirements in a different sequence than they are described here, if this appears to be more logical for a given project, e.g., skip to unit space requirements after developing site requirements.

1:361 PROJECT AND SITE REQUIREMENTS

The design of the sitework and utilities will be executed after a successful proposal for the building is identified. However, there are a number of project and site requirements that must be defined earlier, and identified by the RFP/RFTP:



		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
PROJECT REQUIREMENTS	CONTEXT	●			
	MASTER PLAN CONSIDERATIONS		●		●
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS				●
	CIRCULATION - PEOPLE, VEHICLES				●
	BUILDING ADJACENCY				●
	UTILITY AVAILABILITY				●
SITE SUBSYSTEMS REQUIREMENTS	GRADING				●
	PLANTING				●
	PAVING				●
	WATER				●
	SEWER				●
	ELECTRICAL				●
	COMMUNICATIONS				●

Define project requirements which set the context for the erection and intended use of the facility. Define the type of building, its function and its intended relationship to the adjacent facilities and the installation. This will provide the proposers and their designers with an understanding of the overall project.

Locate the project site and site access routes as would be done conventionally. Review the *systems data for any* influence on designation of the transporation routing due to size or weight.

Provide as much information about the project and site as is currently known or available, including such information as:

- Existing contours, vegetation and subsurface conditions.
- Existing utilities.
- Existing adjacent structures
- Master planning requirements that will be considered during site design, e.g., vistas, parking and traffic plan.

This data should be provided "For Information Only," but when proposers are provided with such information, they are likely to minimize price allowances for contingencies.

Review systems data to identify any special delivery requirements, including storage, on-site production facilities or rail sidings. Where such requirements are necessary, state what provisions will be made.

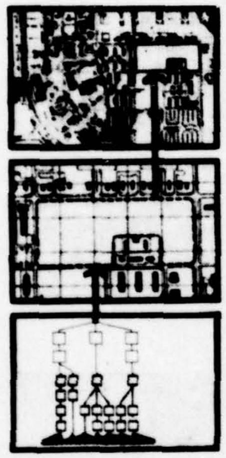
Identify site/building interface requirements which the proposer must accommodate versus those which he must establish. For example, rolling topography may require that the building system accommodate a pre-determined grade slope up to 1:8. On the other hand, require that the proposer establish the precise location and nature of utility connections.

Define under site subsystem requirements, those interface conditions which the proposer must supply with his proposal. Require that he be specific in order that all proposals can be compared during evaluation; this will also assure ready access to the data during site and utility design.

Define those building/site interface requirements which the proposers must provide, and incorporate them under building planning requirements (Ref. 1:362).

1:362 BUILDING PLANNING REQUIREMENTS

Express requirements which will determine the building layout in performance terms, to allow for the widest range of accessible solutions.



BUILDING PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
ADJACENCY OF FUNCTIONAL GROUPS			●	
CONFIGURATION			●	

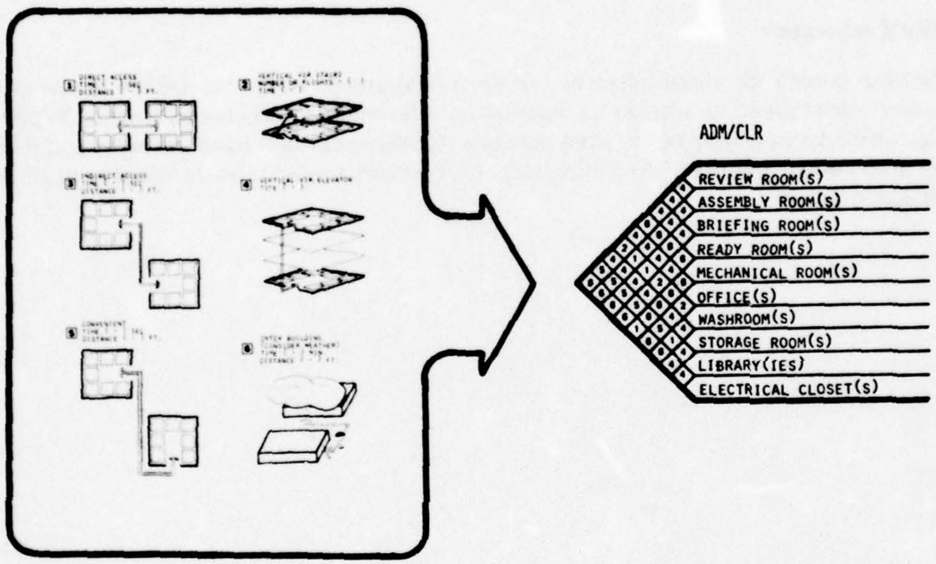
This will give the proposer the clearest understanding of the user's needs, while still permitting the proposer to incorporate these needs within the capabilities of his building system.

Adjacency of Functional Groups

Define each major grouping of spaces, and how these groups must relate to each other. (See "Functional Group Requirements," 1:364). This will guide the proposer in arranging these major groupings, and help assure that the layouts will satisfy the user's needs. Express these adjacency requirements in terms of circulation, vision and sound, using the following considerations as a guide.

Circulation

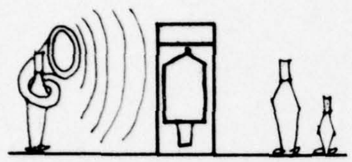
Define adjacency of functional groups by developing optimum criteria for travel distance and time between functional groups of spaces, to demonstrate which groups must relate most closely with other groups.



Require the proposer to accommodate the maximum number of people which it is anticipated *will move from one functional group to another* during peak traffic periods. Define the frequency and size of portable equipment required to be moved between functional groups of spaces. This will affect the connecting corridor, lobby, door types and sizes.

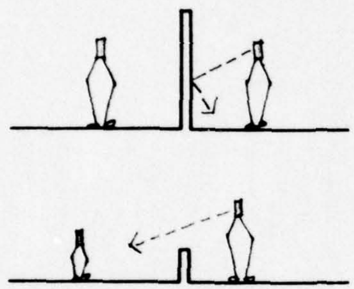
Define exit criteria by means of reference standards, codes or interpretation thereof, to facilitate proposer understanding and proposal evaluation.

Develop criteria for limiting access to functional groups when applicable. Security areas are one frequent need; storage and maintenance areas as well as private quarters may also require limited accessibility.



Acoustical Adjacency

Establish criteria for acoustical separation of functional groups of spaces when this is desired. For example, inform the proposer that key punch and machine rooms must not be acoustically adjacent to quiet office areas, but allow the proposer and designer to solve this either through construction methods or isolated location.



Visual Adjacency

Develop criteria for visual adjacency of functional groups of spaces. Define where visual barriers are required, or where visual access must be maintained between functional groups, e.g., visual barriers may be required between maintenance-trash handling areas and lobby/reception areas, but main circulation routes for visitors should provide visual contact with reception areas.

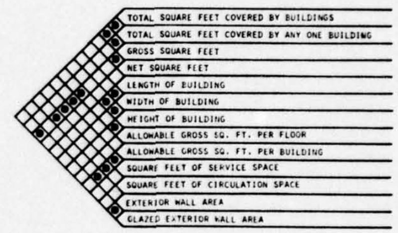
Configuration

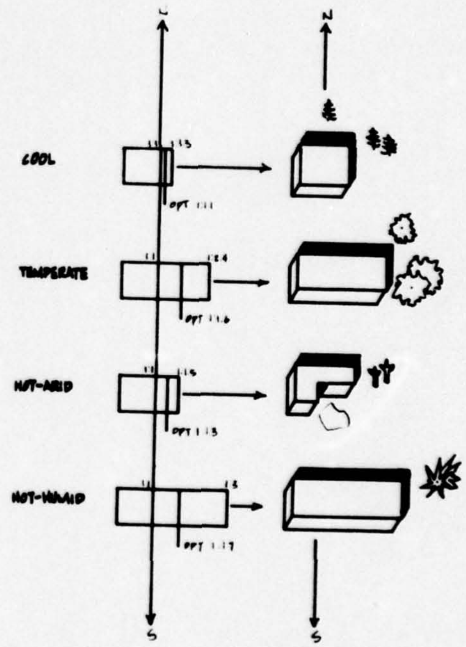
Establish performance criteria to govern the configuration of the building, still permitting the widest latitude of design solutions. These will assist the proposers, during design, as a guide in developing user-acceptable solutions.

Establish dimensional and area relationship only when applicable, e.g., the acceptable ratio of circulation and service area to gross square feet; or building coverage to site size. See the marginal illustration for other examples.

Base configuration criteria upon master plan considerations, specific environmental conditions and esthetics. For example, the environmental conditions may have a valid effect upon length-to-width-to-height relationships. If the climate is cold it is more efficient to heat a building with a 1L:1W ratio; or, if the climate is predominantely hot and humid, a building is more efficiently cooled if it has a ratio 1.7L:1W. On the other hand, a building in hot and dry climate is more efficiently cooled when it is planned in such a way that it produces part of its own shade, *i.e.*, suggesting the use of court yards. Weigh such requirements against esthetic and master plan configurations, and then establish an acceptable range of requirements.

Dictate specific heights or number of stories only when absolutely necessary. Give a range of stories, or massing desired of major elements, if possible.





1:363 BUILDING SUBSYSTEM REQUIREMENTS

Establish building subsystem requirements as indicated in the diagram below. The general content of each subsystem is defined, with directions for the type of criteria to be expressed prescriptively versus the type of criteria to be described in performance terms. References are given to the standards and sources when appropriate.

BUILDING SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FOUNDATIONS		●		
VERTICAL + HORIZONTAL STRUCTURE			●	
VERTICAL TRANSPORTATION			●	
ROOF			●	
EXTERIOR WALLS			●	
INTERIOR SPACE DIVISION			●	
HVAC		●		
ELECTRICAL		●		
PLUMBING		●		
LIGHTING			●	
COMMUNICATIONS		●		

Foundations

Specify foundations in prescriptive and performance terms. Define prescriptively such requirements as:

Minimum depth below grade.

Concrete standards for materials and methods.

This type of prescriptive requirement is based upon accepted engineering solutions. The state of the art of foundation subsystem development is such that prescriptive requirements will not inhibit the proposers.

These requirements can readily be specified in performance terms.

Provide numerical values for such performance criteria as:

- allowable bearing pressures;
- resistance to forces;
- interface with structure;
- water resistance for basements.

Avoid requirements for specific types of foundations, such as continuous footings, piles, grade beams, etc., which can inhibit a proposer and result in adverse costs.

Include excavating and backfilling with site work. Require the proposer to provide the criteria and detailed plans for this work, for later incorporation when completing the site design and documentation.

Vertical and Horizontal Structure

Develop performance requirements for the structural subsystems. Since materials and components will vary considerably from one system to another, definition of requirements in prescriptive terms will inhibit a proposer and result in adverse costs.

Include performance requirements for columns and bearing walls, and floor and roof structure; also include performance requirements for slabs on grade.

Structural subsystem performance requirements have been developed for numerous, existing systems projects (Ref. 2:410). Use these sources, in conjunction with a comparison of feasible systems versus project requirements, (Ref. 1:302) to develop appropriate criteria.

Roof

Establish performance requirements for the roof subsystem. The materials and methods used for these subsystems will vary considerably among system proposers. New single-ply membranes are presently in competition with a wide variety of bituminous roofing assemblies, and in some cases with metal roofing. Insulation types and substrates vary widely. Therefore, use performance criteria to define what is required of this subsystem.

Refer to "Outside Information Sources" in this section (Ref. 1:302) for examples of such requirements. Requirements for bonded roofs may be included in accordance with local availability or customary user performance, taking into account that industry's responsibility for stringent bonds and guarantees is in a state of transition. Give specific consideration to requiring weathering certification tests, positive drainage, fire, wind uplift and thermal resistance. Requirements for resistance to wear due to rooftop equipment will depend upon the use of such equipment at the project.

Exterior Walls

A wide variety of construction and materials will be used in this subsystem. Define requirements for exterior walls in performance terms only (prescriptive requirements will inhibit proposer response). Include windows and doors in this section; do not include structural bearing requirements, which are included under structural.

If the project is a storage type facility, most or all of the available systems may have exterior walls constructed of the same or similar materials, *e.g.*, pre-engineered, metal buildings. When this is the case, define the requirements in prescriptive and performance terms. For example, establish prescriptive requirements for thicknesses and type of materials, but define finishes, thermal resistance and weather resistance in performance terms.

There has been little success in defining esthetic requirements for walls without adverse limitation of proposer response. See "Outside Information Sources" (1:302) for examples of criteria which have been developed for other recent projects.

Interior Space Division

Utilize performance terms in defining space division, since prescriptive requirements would inhibit the proposer. The construction and materials will vary widely among systems, especially in closed systems adaptive to housing and storage type facilities. Performance requirements for this subsystem have been developed for several recent projects. The sample specification in the appendix (2:320) should be used as a typical format for the requirements.

HVAC

Develop prescriptive and performance requirements, most of which can readily be expressed in performance terms, though options required for specific functions, or for sophisticated environmental controls are best specified in prescriptive terms.

Establish overall requirements for the HVAC system in performance terms, using recognized reference standards. When several types of subsystems will be proposed, establish parallel sets of requirements; e.g., unitary air subsystem requirements will differ from central hydronic, but either may be acceptable, subject ot conformance with the specified requirements.

Define requirements for optional features required of all subsystems in prescriptive terms, e.g., filter requirements, the degree of automation for controls, a renewable maintenance contract, etc.

The time span for performance by this subsystem is difficult to specify, and even more difficult to verify during operation. For this reason, many systems programs have relied upon a renewable maintenance contract, included with the proposer's bid, to assure the maintenance of performance over a specified period of time. When the project permits, it is recommended that provisions for such contract be included.

Electrical

Establish requirements for the electrical subsystem in prescriptive and performance terms. In the private sector this subsystem is highly regulated by codes and authorities; much of such regulation is highly prescriptive and has remained unchanged by "systems" pressures. Incorporate these standards by reference or inclusion as would be done for a conventional project. See "Outside Information Sources" (1:302).

Define requirements for the overall electrical system in performance terms. Incorporation of this subsystem into each system will vary with the nature of the subsystems with which it must interface, e.g., differently in a system with concrete walls and partitions than with frame walls.

Plumbing

Define this subsystem using prescriptive and performance requirements. Use performance requirements to define criteria reflecting accepted engineering practice, such as:

Noise criteria
Structural support
Fixture quantities

Use performance requirements when they presently occur in applicable codes or standards.

Define requirements prescriptively when it is desirable to define the quality of the materials, e.g., where galvanized iron pipe is acceptable. Define requirements prescriptively when acceptable codes and standards are also inherently prescriptive, such as for traps and vents.

Identify fixtures prescriptively, using generic terms for fixture type, e.g., siphon jet, elongated bowl, flush valve type.

Specify lavatories and sinks by receptacle size rather than specific type; define fittings prescriptively. See unit space subsystems (1:366) for requirements for fixtures and utilities in relationship to unit spaces.

Lighting

Develop requirements for this subsystem in performance terms only. Lighting fixtures and solutions vary widely among systems, and prescriptive requirements will inhibit the response of many proposers.

The scope and nature of the required lighting subsystem will depend upon the building type and project requirements; in some instances it will be advisable to combine other subsystems with lighting, to form a composite subsystem, *i.e.*, a lighting/ceiling subsystem.

Communications

Define requirements for this subsystem in prescriptive and performance terms, including telephone, intercom, alarm clock, and television, to the extent that they are required.

Define requirements for complex equipment and tor equipment which must interface with existing communication lines in prescriptive terms. Compare such installation requirements with available building systems, to determine if problems may occur.

Establish performance requirements for the system layout, to permit the proposer to integrate this subsystem with his design without restriction. Establish performance requirements only for all non-complex equipment, the function of which can be readily expressed, *e.g.*, simple fire alarm equipment.

1:364 FUNCTIONAL GROUP REQUIREMENTS

Define functional group requirements in performance terms to allow the proposer the flexibility of a wide range of solutions to the building design requirements.

FUNCTIONAL GROUP REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	

Functional group is used herein to designate a combination of unit spaces (see 1:365 for a description of unit space), and smaller functional groups where necessary, which together are intended to perform a task. For example, an apartment represents a functional group, composed of unit spaces such as sleeping spaces, living space, dining space, kitchen space, bathroom space and storage space. A functional group of a higher order is a given mix of apartments, including laundry and recreational facilities. Define functional group requirements, to establish the relationships which will guide the proposer during the development of building design.

Task Performance Considerations

List those items which are considered important to help define the functional groups. These items will serve as a guideline for the proposer as he arranges the functional groups within the building being submitted, and can also be used during proposal evaluation to determine how well the proposer responded to each requirement. Allocate a relative rate of importance to each requirement, to be utilized later as part of the rating system for proposal evaluation. See 1:421 for a more detailed explanation of the rating system.

When compiling a list of task performance considerations, first decide the nature of the task which the functional group is intended to serve. Then include a brief description of the task as a part of the presentation of the requirement. Next make a list of activities which will be performed within the functional group, and indicate for each the relative importance of the design consideration.

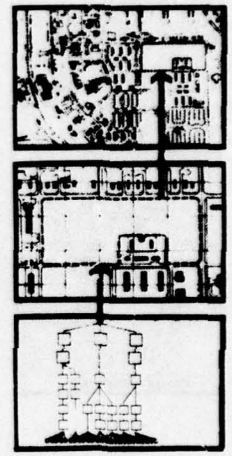
Quantity — Adjacency of Unit Spaces

Indicate the number and type of unit spaces which will make up each functional group. Also define the adjacency requirements, which will guide the proposer in arranging the unit spaces into functional groups and floor plans. The considerations previously described for adjacency of functional groups also apply to adjacency of unit spaces. (Ref. 1:362).

1:365 UNIT SPACE PLANNING REQUIREMENTS

A unit space is usually characterized as a room, although it may also be an open or semi-open area serving a specific purpose, e.g., one end of a lobby serving as a reception area. Define the spatial and functional requirements for unit spaces in performance terms. This will allow variation of the dimensions and configurations which most proposers will have within their individual building systems. It will also allow for the variety of relationships among unit spaces, which will likely occur when these unit spaces are combined into various functional groups.

UNIT SPACE PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SPATIAL			●	
FUNCTIONAL DESCRIPTION			●	



Spatial

Define the maximum and minimum acceptable requirements for floor area and ceiling height for each unit space.

Functional Description

Describe the activities which the unit space will be expected to accommodate. In addition to their activities, list the numerical range of persons who will use the space. Indicate this range on three levels:

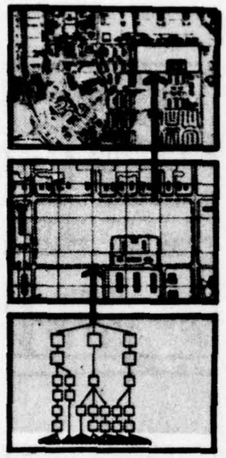
MINIMUM: The smallest number remaining for any reasonable length of time.

NORMAL: During an average day, the greatest number of users anticipated at the same time; (this number should be accommodated with the greatest comfort).

MINIMUM: The highest number to be provided for at the same time (not necessarily at maximum comfort).

1:366 UNIT SPACE SUBSYSTEM REQUIREMENTS

Establish prescriptive and performance requirements for each unit space subsystem, to define how the subsystems relate to each space and to provide a further guide to how the spaces are used. The subsystems to be described in prescriptive terms versus performance terms are given below.



UNIT SPACE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FIXED EQUIPMENT		●		
MOVABLE FURNISHINGS		●		
PLUMBING		●		
HVAC		●		
LIGHTING			●	
COMMUNICATIONS /POWER		●		

Identify all pieces of fixed equipment which must be accommodated and whether included with the proposal or by others. Give dimensions if they cannot vary; otherwise indicate the range of probable dimensions. Define all required service connections in prescriptive terms. Material can be specified in detail without restricting the proposer's ability to develop the unit space within the capabilities of his system.

Movable Furnishings

Identify all movable furnishings which must be accommodated and their intended function. Give dimensions of furnishings which will not vary; otherwise indicate the range of probable dimensions.

HVAC

Define the acceptable ranges of temperature, humidity, ventilation, and exhaust requirements. Note controls required.

Lighting

Indicate quality and quantity of light required for the space, and control requirements for the lighting; do not indicate type or location of fixtures. Note controls for other unit spaces, or controls for this unit space which are located elsewhere.

Communications/Power

Define communication and power requirements and their function in this space, except where previously noted for equipment service connection. Express location requirements in performance terms.

This concludes the preparation of the RFP/RFTP. Proceed to 1:381.

SECTION SEVEN

PACKAGE STRATEGY

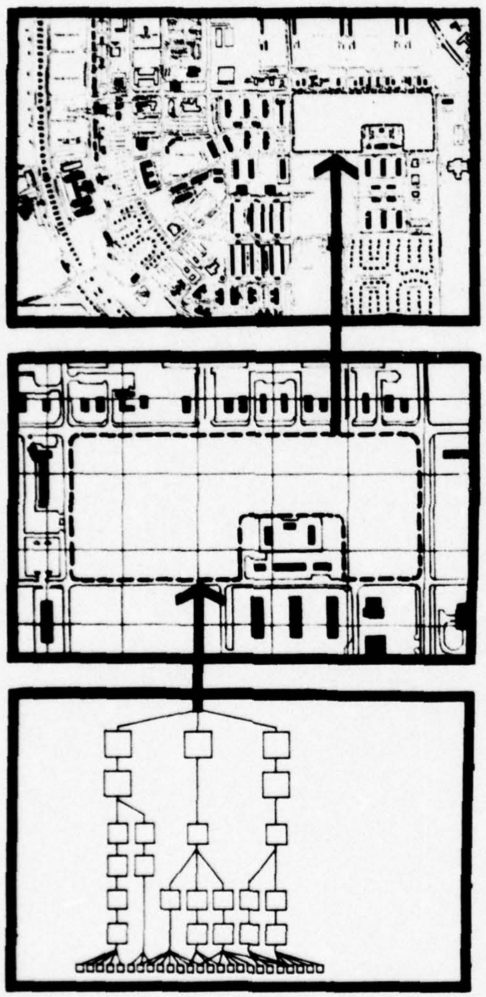
TABLE OF CONTENTS

1:370 GENERAL DESCRIPTION: PACKAGE STRATEGY

(This section is continued from section 1:338)

In this phase of the package strategy, develop RFP/RFTP requirements which will allow proposers which have a wide variety of dissimilar systems to respond competitively. The proposals developed in response to the RFP/RFTP will include designs for the site, utilities and building(s) most appropriate to their system. This strategy will assure maximum coordination of site, utilities, and building design and construction. It will also afford maximum project control while *assuring maximum response from a diversity of systems.*

Organize the technical section of the specification to conform with arrangement of requirements presented in this section. The diagram on the following page illustrates this structure. It is an expansion of the diagram first presented and on which the project requirements are based (Ref. 1:291). A brief verbal description and illustration of what each set of requirements involves is found on the left.



Project Requirements relate to the entire work to be performed at this time. Such requirements include the context or the existing conditions and master planning considerations which define the desired relationship between existing facilities, the facilities currently being constructed and future facilities.

Site Planning Requirements affect the way in which the buildings may be situated on the site. These will include any special activities or physical characteristics of the site which affect building siting, adjacency requirements of the buildings, circulation of people and vehicles about the site including vehicle parking, and utility access.

Site Subsystems Requirements *describe the sitework subsystems sufficiently to allow the* proposer to develop a proposal.

Building Planning Requirements include adjacency requirements of functional groups, circulation requirements, and any restrictions in building configuration.

Building Subsystems Requirements describe the building subsystems sufficiently to allow the proposer to develop a bid and construct the buildings.

Functional Group Planning Requirements concern a set of spaces intended to perform a specif-if function. Functional group requirements define the function, the relationship of the unit spaces which comprise the group. Example: an administrative suite.

Unit Space Planning Requirements describe the way in which the unit spaces must be structured in order to function appropriately while allowing for a variation of solutions. Unit space represents a typical room or area intended to perform a given function. Example: a bedroom for 1 bachelor officer would be a unit space.

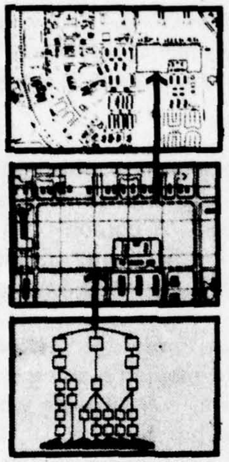
Unit Space Subsystem requirements describe the items and services which are necessary for a space to function.

Requirement group	Requirement	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
PROJECT REQUIREMENTS	CONTEXT		●		
	MASTER PLAN CONSIDERATIONS		●		
SITE PLANNING REQUIREMENTS	SITE ACTIVITIES CONSIDERATIONS			●	
	CIRCULATION - PEOPLE, VEHICLES			●	
	BUILDING ADJACENCY			●	
	UTILITY AVAILABILITY			●	
SITE SUBSYSTEMS REQUIREMENTS	GRADING		●		
	PLANTING		●		
	PAVING		●		
	WATER		●		
	SEWER		●		
	ELECTRICAL		●		
	COMMUNICATIONS		●		
BUILDING PLANNING REQUIREMENTS	ADJACENCY OF FUNCTIONAL GROUPS			●	
	CONFIGURATION			●	
BUILDING SUBSYSTEMS REQUIREMENTS	FOUNDATIONS		●		
	VERTICAL + HORIZONTAL STRUCTURE			●	
	VERTICAL TRANSPORTATION			●	
	ROOF			●	
	EXTERIOR WALLS			●	
	INTERIOR SPACE DIVISION			●	
	HVAC		●		
	ELECTRICAL		●		
	PLUMBING		●		
	LIGHTING			●	
	COMMUNICATIONS		●		
FUNCTIONAL GROUP REQUIREMENTS	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	
UNIT SPACE PLANNING REQUIREMENTS	SPATIAL			●	
	FUNCTIONAL DESCRIPTION			●	
UNIT SPACE SUBSYSTEMS REQUIREMENTS	FIXED EQUIPMENT		●		
	MOVABLE FURNISHINGS		●		
	PLUMBING		●		
	HVAC		●		
	LIGHTING			●	
	COMMUNICATIONS /POWER		●		

The diagram on this page indicates the recommended structure of requirements and the best way to express each requirement for this strategy.

A detailed explanation of how to develop each set of requirements is found on the following pages. A portion of the diagram is found at the beginning of each section keying the explanation to the master diagram.

Read through this entire section and the section on developing a rating system (Ref. 1:421), prior to commencing work on any part of the technical RFP/RFTP. Then using the program developed earlier (Ref. 1:291), proceed to develop RFP/RFTP requirements and criteria as indicated. Do not hesitate to develop requirements in a different order than they are discussed here, *e.g.*, skip to unit space requirements after developing site requirements, where this proves easier.



1:371 PROJECT REQUIREMENTS

Under this strategy the proposer will be completing all design and layout including the building and the site. Project requirements must be defined to establish conditions under which the project will be designed and constructed.

PROJECT REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
CONTEXT		●		
MASTER PLAN CONSIDERATIONS		●		

Define project requirements which set the context for the erection and intended use of the facility. First, define the type of building, its function and its intended relationship to the adjacent facilities and the installation. This will provide the proposers and their designers with an understanding of the overall project.

Locate the project site and site access road as would be done conventionally. Review the systems data for any influence on designation of the transportation routing due to size or weight.

Review systems data to identify any special delivery requirements including storage on site production facilities or rail sidings. Where such requirements are necessary, state what provisions will be made.

Provide as much information about the project and site as is currently available or known, including such information as:

Existing contours, vegetation and subsurface conditions.

Existing utilities.

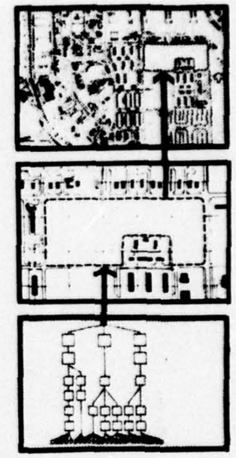
Existing, adjacent structures.

Master planning requirements that will be considered during site design, e.g., vistas, parking and traffic plan.

1:372 SITE PLANNING REQUIREMENTS

Develop performance requirements which will afford the proposer the greatest degree of flexibility in developing the site plan to best utilize the characteristics of his building system.

SITE PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SITE ACTIVITIES CONSIDERATIONS			●	
CIRCULATION - PEOPLE, VEHICLES			●	
BUILDING ADJACENCY			●	
UTILITY AVAILABILITY			●	



Site Activities Considerations

Define activities which must be considered during the site design, including such requirements as on-site parking, service courts, storage areas, site maintenance including snow removal for the design of walkways, ramps, steps, site lighting fixtures, grade changes, etc. Describe other special activities and the provisions required; for example, if the project includes a headquarters building and "flag raising" or other ceremonies are anticipated, describe these in adequate detail to allow the proposer to accommodate these activities in his layout.

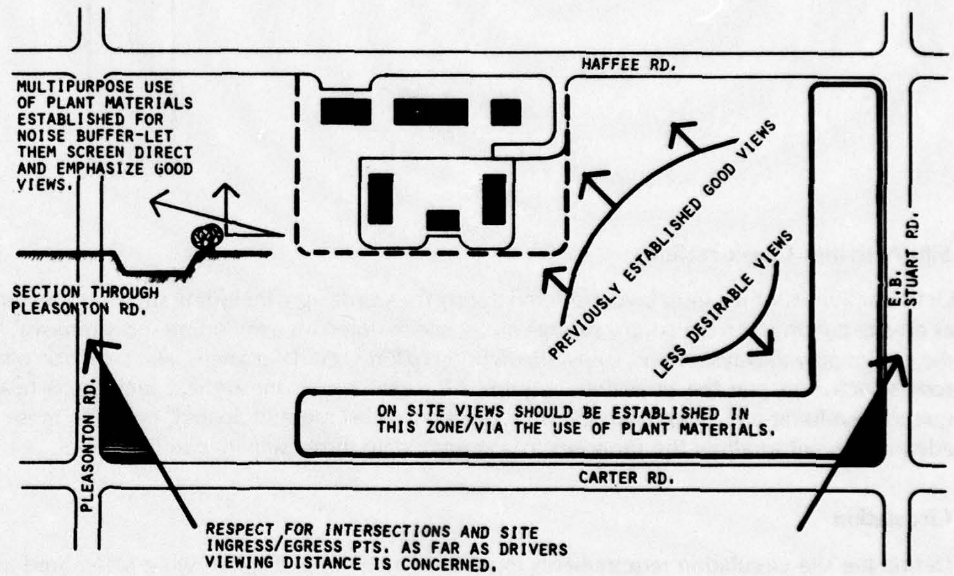
Circulation

Define the site circulation requirements in performance terms. Explain what is required and what type and volume of traffic is expected, but do not indicate roads or walkways in order to avoid limitations upon the plånning solutions open to the proposers. Include requirements for emergency vehicles, describe the requirements for delivery of people and goods, and indicate any weather conditions which may affect the layout. Coordinate these circulation requirements with those for building planning, (Ref. 1:374) and unit space requirements, (Ref. 1:377) wherein building circulation and such items as loading docks will also be specified in performance terms.

Building Adjacency

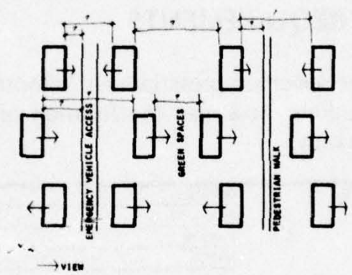
Since the buildings and the site plan are being designed by the proposer, it is necessary to develop guidelines to direct the proposer in siting the buildings in accordance with the program requirements in developing building adjacency guidelines include the following:

Visual Considerations—These concern the environmental conditions of the site, including 'good view-bad view' considerations.

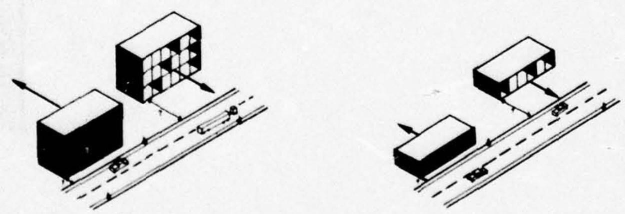


Functional Considerations—Indicate the relationships of building to parking, to existing facilities, and to overall master plan requirements.

Distance Relationships — Define desired maximum/minimum relationships between buildings, related to story height, emeregency vehicle access, distance required for a walkway between buildings, distance between ends of buildings, between end-and-front, end-and-back, back-to-back, *front-to-front* and *back-to-front*.



Consider how building height and direction of view needs to affect the proximity of the building to a main road, and whether the introduction of planting used as a screen will affect this distance.



Also consider the effects of building height and direction of view upon the location of the pedestrian walks and green spaces.

Utility Distribution

Indicate existing utility lines only, including size and capacities. Do not attempt to anticipate the distribution of utilities within the site. The proposer will complete the utility layout to best serve the design being submitted.

1:373 SITE SUBSYSTEMS REQUIREMENTS

Site subsystem materials may be specified prescriptively without unduly restricting the proposer's possible plan configurations; however, the location of these subsystems must be specified *in performance terms only*.

SITE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
GRADING		●		
PLANTING		●		
PAVING		●		
WATER		●		
SEWER		●		
ELECTRICAL		●		
COMMUNICATIONS		●		

Grading

Indicate existing grades and specify the degree of alteration which is permitted to produce final grades. *Define the methods of backfilling and grading as would be done conventionally,* and where possible indicate sources of backfill material; do not indicate final grades, since this will limit the proposer's overall design possibilities.

Planting

Depending on the way in which the siting requirements are developed, the amount of planting will vary with different layouts, although each may be acceptable, depending upon whether planting is utilized for screening or other purposes. It will be necessary, however, to specify minimum quantities of trees and shrubs as well as sodding and seeding requirements. Make several combinations of acceptable quantities which are approximately equal in cost, *i.e.*, one with more trees and fewer shrubs, one with more shrubs and fewer trees and one with an equal mixture. This will allow the various proposers to utilize the combination which best adapts to their particular layout.

Specify the type of plants required and the manner of installation in prescriptive terms, since this will not restrict the proposer's design.

Paving

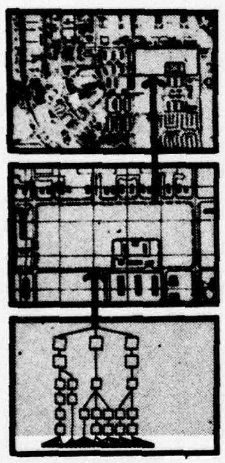
Specify all paving types required and the method of construction in prescriptive terms. Do not indicate where paving will occur or the minimum/maximum amounts required. These requirements will be covered under circulation requirements. Make it clear to the proposer what type of paving should be used for each type of circulation which he must accommodate in the site layout. (Ref. 1:372.)

Water and Sewer

Indicate all existing drainage conditions and the local determinants for designing storm drainage. The rest of the design and layout is dependent upon the buildings being serviced and the funished grades supplied by the proposer. Specify the materials and methods of construction desired in prescriptive terms, leaving the layout and sizing to be completed by the proposer. Indicate any special requirements for the fire department, to allow the design to accommodate its equipment, including distance between outlets, hook-up requirements, proximity to curbs and fire lanes.

Electrical and Communications

Indicate prescriptively the means by which both permanent and temporary power will be supplied. Define the products and installation methods to be used for both electrical and communications. Do not give indications of where these will be located, since this will restrict different plan layouts. It will be necessary, however, to establish a guideline for the proposer's design of the layout; to do this, indicate lighting levels and communication requirements for the various site activities. Give lighting levels required for parking lots, pedestrian walks and street lighting, but the number and location of the fixtures will be dependent upon the layout provided by the proposer in conformance with the lighting levels specified.



1:374 BUILDING PLANNING REQUIREMENTS

Express requirements which will determine the building layout in performance terms, to allow for the widest range of possible solutions.

BUILDING PLANNING REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	ADJACENCY OF FUNCTIONAL GROUPS			●	
	CONFIGURATION			●	

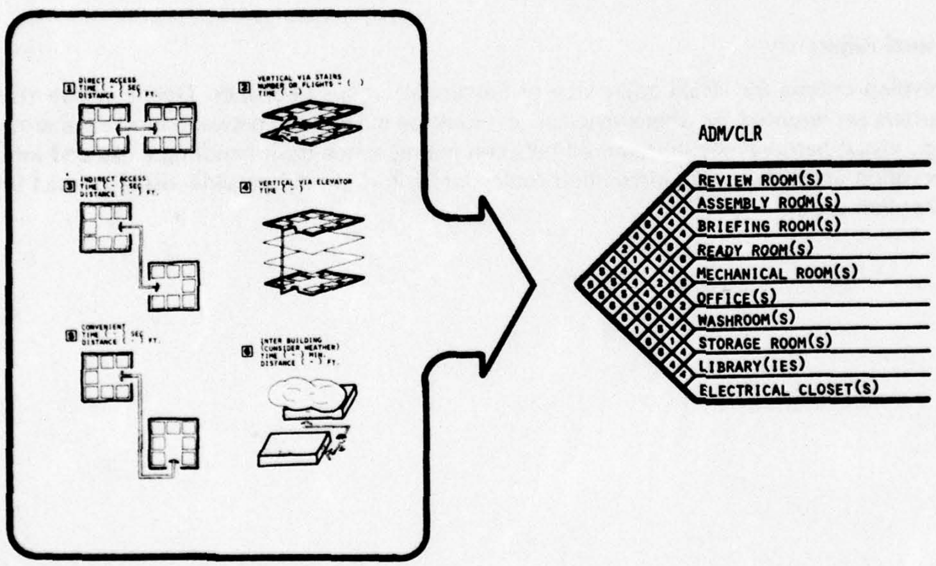
This will give the proposer the clearest understanding of the user's needs, while still permitting the proposer to accommodate these needs within the capabilities of his building system.

Adjacency of Functional Groups

Define each major grouping of spaces, and how these groups must relate to each other. (See "Functional Group Requirements," 1:376.) This will guide the proposer in arranging these major groupings, and help assure that the layouts will satisfy the user's needs. Express these adjacency requirements in terms of circulation, vision and sound, using the following considerations as a guide.

Circulation

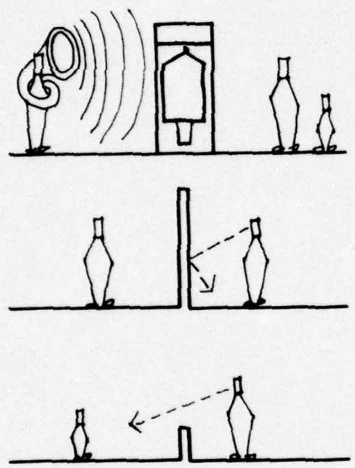
Define adjacency of functional groups by developing optimum criteria for travel distance and time between functional groups of spaces, to demonstrate which groups must relate most closely with other groups.



Require the proposer to accommodate the maximum number of people which it is anticipated will move from one functional group to another during peak traffic periods. Define the frequency and size of portable equipment required to be moved between functional groups of spaces. This will affect the connecting corridor, lobby, door types and sizes.

Define exit criteria by means of reference standards, codes or interpretation thereof, to facilitate proposer understanding and proposal evaluation.

Develop criteria for limiting access to functional groups when applicable. Security areas are one frequent need; storage and maintenance areas as well as private quarters may also require limited accessibility.



Acoustical Adjacency

Establish criteria for acoustical separation of functional groups of spaces when this is desired. For example, inform the proposer that key punch and machine rooms must not be acoustically adjacent to quiet office areas, but allow the proposer and designer to solve this either through construction methods or isolated location.

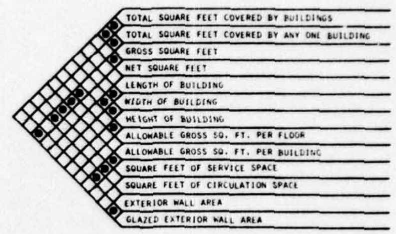
Visual Adjacency

Develop criteria for visual adjacency of functional groups of spaces. Define where visual barriers are required, or where visual access must be maintained between functional groups, e.g., visual barriers may be required between maintenance-trash handling areas and lobby/ reception areas, but main circulation routes for visitors should provide visual contact with reception areas.

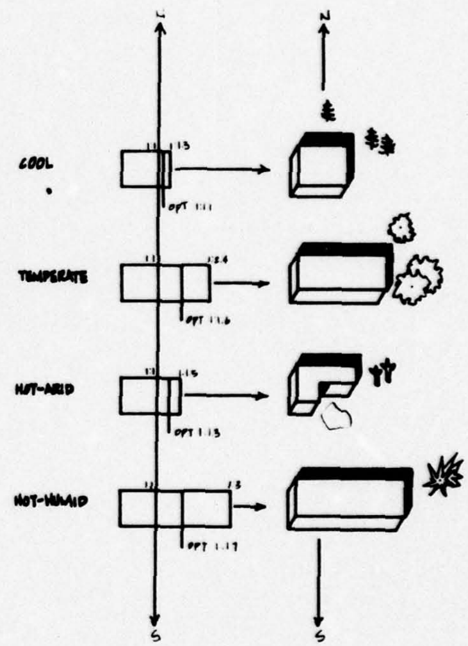
Configuration

Establish performance criteria to govern the configuration of the building, still permitting the widest latitude of design solutions. These will assist the proposers, during design, as a guide in developing user-acceptable solutions.

Establish dimensional and area relationships only when applicable, *e.g.*, the acceptable ratio of circulation and service area to gross square feet; or building coverage to site size. See the marginal illustration for other examples.



Base configuration criteria upon master plan considerations, specific environmental conditions and esthetics. For example, the environmental conditions may have a valid effect upon length-to-width-to-height relationships. If the climate is cold it is more efficient to heat a building with a 1L:1W ratio; or, if the climate is predominantely hot and humid, a building is more efficiently cooled if it has a ratio 1.7L:1W. On the other hand, a building in hot and dry climate is more efficiently cooled when it is planned in such a way that it produces part of its own shade, *i.e.*, suggesting the use of court yards. Weigh such requirements against esthetic and master plan configurations, and then establish an acceptable range of requirements.



Dictate specific heights or number of stories only when absolutely necessary. Give a range of stories, or massing desired of major elements, if possible.

Design & Doc

1:375 BUILDING SUBSYSTEM REQUIREMENTS

Establish building subsystem requirements as indicated in the diagram below. The general content of each subsystem is defined below, with directions for the type of criteria to be expressed prescriptively versus the type of criteria to be described in performance terms. References are given to the standards and sources when appropriate.

BUILDING SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FOUNDATIONS		●		
VERTICAL + HORIZONTAL STRUCTURE			●	
VERTICAL TRANSPORTATION			●	
ROOF			●	
EXTERIOR WALLS			●	
INTERIOR SPACE DIVISION			●	
HVAC		●		
ELECTRICAL		●		
PLUMBING		●		
LIGHTING			●	
COMMUNICATIONS		●		

Foundations

Specify foundations in prescriptive and performance terms. Define prescriptively such requirements as:

Minimum depth below grade.

Concrete standards for materials and methods

This type of prescriptive requirement is based upon accepted engineering solutions. The state of the art of foundation subsystem development and use is not such that prescriptive requirements will inhibit the proposers.

Provide values for such performance terms as:

Allowable bearing pressures.
Resistance to forces
Interface with structure.
Water resistance for basements.

These requirements can readily be specified in performance terms.

Avoid requirements for specific types of foundations, such as continuous footings, piles, grade beams, etc., which can inhibit a proposer and result in adverse costs.

Vertical and Horizontal Structure

Develop performance requirements for the structural subsystems. Since materials and components will vary considerably from one system to another, definition of requirements in prescriptive terms will inhibit a proposer and result in adverse costs.

Include performance requirements for columns and bearing walls, and floor and roof structure; also include performance requirements for slabs on grade.

Structural subsystem performance requirements have been developed for numerous existing systems projects (Ref. 1:302). Use the sources, in conjunction with a comparison of feasible systems versus project requirements, (Ref. 1:371) to develop appropriate criteria.

Roof

Establish performance requirements for the roof subsystem. The materials and methods used for these subsystems will vary considerably among system proposers. New single-ply membranes are presently in competition with a wide variety of bituminous roofing assemblies and in some cases with metal roofing. Insulation types and substrates vary widely. Therefore, use performance criteria to define what is required of this subsystem.

Review "Outside Information Sources" (Ref. 1:302), for examples of such requirements. Requirements for bonded roofs may be included in accordance with local availability or customary user performance, taking into account that industry's responsibility for stringent bonds and guarantees is in a state of transition. Give specific consideration to requiring weathering certification tests, positive drainage, fire, wind uplift and thermal resistance. Requirements for resistance to wear due to rooftop equipment will depend upon the use of such equipment at the project.

Exterior Walls

A wide variety of construction and materials will be used in this subsystem. Define requirements for exterior walls in performance terms only. Describing requirements prescriptively for this subsystem will inhibit proposer response. Include windows and doors in this section; do not include structural bearing requirements, which are included under structural.

If the project is a storage type facility, most or all of the available systems may have exterior walls constructed of the same or similar materials, e.g., pre-engineered, metal buildings. When this is the case, define the requirements in prescriptive and performance terms. For example, establish prescriptive requirements for thicknesses and type of materials, but define finishes, thermal resistance and weather resistance in performance terms.

It should be noted that there has been little success in defining positive esthetic requirements for this subsystem without adverse limitations of proposer response. See "Outside Information Sources," (1:302) for examples of criteria which have been developed for other projects.

Interior Space Division

Utilize performance terms in defining this subsystem, since prescriptive requirem s would inhibit the proposer. The construction and materials used in this subsystem will v ry widely among systems, especially in closed systems adaptive to housing and storage type facilities. Performance requirements for this subsystem have been developed for several recent projects (Ref. 2:315).

The sample specification in the appendix 2:320 should be used as a typical format for the requirements for this subsystem.

HVAC

Develop prescriptive and performance requirements for this subsystem. Most requirements can readily be expressed in performance terms, but options required for specific building-use functions, or for sophisticated environmental controls are best specified in prescriptive terms.

Establish overall requirements for the HVAC system in performance terms, using recognized reference standards. When several types of subsystems will be proposed, establish parallel sets of requirements (*e.g.*, unitary air subsystem requirements *will differ from central hydronic*, but either may be acceptable, subject to conformance with the specified requirements).
Define requirements for optional features required of all subsystems in prescriptive terms, e.g., filter requirements, the degree of automation for controls, etc.

The time span for performance by this subsystem is difficult to specify, and even more *difficult* to verify during operation. For this reason, many systems programs have relied upon renewable maintenance of quality of performance over a specified period of time. When the project permits, it is recommended that provisions for such contract be included.

Electrical

Establish requirements for the electrical subsystem in prescriptive and performance terms. In the private sector this subsystem is highly regulated by codes and authorities; much of such regulation is *highly-prescriptive* and has remained unchanged by "systems" pressures. Incorporate these standards by reference or inclusion as would be done for a conventional project.

Define requirements for the overall electrical system in performance terms. Incorporation of this subsystem into each system will vary with the nature of the subsystems with which it must interface, e.g., differently *in a system with concrete* walls and partitions than with a system with frame walls.

Plumbing

Define this subsystem using prescriptive and performance requirements. Use performance requirements to define criteria reflecting accepted engineering practice, such as:

- Noise criteria
- Structural support
- Fixture quantities

Use performance requirements when they presently occur in applicable codes or standards.

Define requirements prescriptively when it is desirable to define the quality of the materials, *e.g.*, where galvanized iron pipe is acceptable. Define requirements prescriptively when acceptable codes and standards are also inherently prescriptive, such as for traps and vents. Refer to "Outside Information Sources" for examples of this on other projects. (Ref. 1:302.)

Identify fixtures prescriptively, using generic terms for fixture type, *e.g.*, siphon jet, elongated bowl, flush valve type.

Specify lavatories and sinks by receptacle size rather than specific type; define fittings prescriptively. See unit space subsystems, 1:378, for requirements for fixtures and utilities in relationship to unit spaces.

Lighting

Develop requirements for this subsystem in performance terms only. Lighting fixtures and solutions vary widely among systems, and prescriptive requirements will inhibit the response of many proposers.

The scope and nature of the required lighting subsystem will depend upon the building type and project requirements; in some instances it will be advisable to combine other subsystems with lighting, to form a composite subsystem, *i.e.*, a lighting/ceiling subsystem.

Lighting performance requirements have been developed on many previous systems projects. Use these sources to develop appropriate criteria.

Communications

Define requirements for this subsystem in prescriptive and performance terms, including telephone, intercom, alarm, clock, and television, to the extent that they are required.

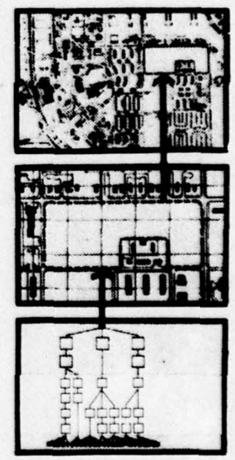
Define requirements for complex equipment and for equipment which must interface with existing communication lines in prescriptive terms. Compare such installation requirements with available building systems, to determine if problems may occur.

Establish performance requirements for the subsystem layout, to permit the proposer to integrate this subsystem with his design without restriction. Establish performance requirements only for all non-complex equipment, the function of which can be readily expressed, e.g., simple fire alarm equipment.

1:376 FUNCTIONAL GROUP REQUIREMENTS

Define functional group requirements *in performance terms to allow the proposer* the flexibility of a wide range of solutions to the building design requirements.

FUNCTIONAL GROUP REQUIREMENTS		PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
	TASK PERFORMANCE CONSIDERATIONS			●	
	QUANTITY - ADJACENCY OF UNIT SPACES			●	



Functional group is used herein to designate a combination of unit spaces (see 1:377 for a description of unit space), and smaller functional groups where necessary, which together are intended to perform a task. For example, an apartment represents a functional group, composed of unit spaces such as sleeping spaces, living space, dining space, kitchen space, bathroom space and storage space. A functional group of a higher order is a given mix of apartments, including laundry and recreational facilities. Define functional group requirements, to establish the relationships which will guide the proposer during the development of building design.

Task Performance Considerations

List those items which are considered important to help define the functional groups. These items will serve as a guideline for the proposer as he arranges the functional groups within the building being submitted, and can also be used during proposal evaluation to determine how well the proposer responded to each requirement. Allocate a relative rate of importance to each requirement, to be utilized later as part of the rating system for proposal evaluation.

See 1:421 for a more detailed explanation of the rating system.

When compiling a list of task performance considerations, first decide the nature of the task which the functional group is intended to serve. Then include a brief description of the task as a part of the presentation of the requirement. Next make a list of activities which will be performed within the functional group, and indicate for each the relative importance of the design consideration.

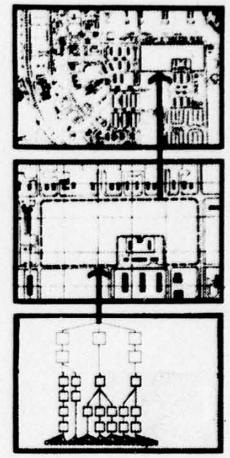
Quantity — Adjacency of Unit Spaces

Indicate the number and type of unit spaces which will make up each functional group. Also define the adjacency requirements which will guide the proposer in arranging the unit spaces into functional groups and floor plans. The considerations previously described for adjacency of functional groups also apply to adjacency of unit spaces. (Ref. 1:374.)

1:377 UNIT SPACE PLANNING REQUIREMENTS

A unit space is usually characterized as a room, although it may also be an open or semi-open area serving a specific purpose, e.g., one end of a lobby serving as a reception area. Define the spatial and functional requirements for unit spaces in performance terms. This will allow variations of the dimensions and configurations which most proposers will have within their individual building systems. It will also allow for the variety of relationships among unit spaces which will likely occur when these unit spaces are combined into various functional groups.

UNIT SPACE PLANNING REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
SPATIAL			●	
FUNCTIONAL DESCRIPTION			●	



Spatial

Define the maximum and minimum acceptable requirements for floor area and ceiling height for each unit space.

Functional Description

Describe the activities which the unit space will be expected to accommodate. In addition to their activities, list the numerical range of persons who will use the space. Indicate this range on three levels:

MINIMUM: The smallest number remaining for any reasonable length of time.

NORMAL: During an average day, the greatest number of users anticipated at the same time; (this number should be accommodated with comfort).

MAXIMUM: The highest number to be provided for at the same time (not necessarily at maximum comfort).

1:378 UNIT SPACE SUBSYSTEM REQUIREMENTS

Establish prescriptive and performance requirements for each unit space subsystem, to define how the subsystems relate to each space and to provide a further guide to how the spaces are used. The subsystems to be described in prescriptive terms versus performance terms are given below.

UNIT SPACE SUBSYSTEMS REQUIREMENTS	PRESCRIPTIVE	PRESC/PERFORMANCE	PERFORMANCE	NOT IN SYSTEM CONTRACT
FIXED EQUIPMENT		●		
MOVABLE FURNISHINGS		●		
PLUMBING		●		
HVAC		●		
LIGHTING			●	
COMMUNICATIONS /POWER		●		

Identify all pieces of fixed equipment which must be accommodated and whether included with the proposal or by others. Give dimensions if they cannot vary; otherwise indicate the range of probable dimensions. Define all required service connections in prescriptive terms. Material can be specified in detail without restricting the proposer's ability to develop the unit space within the capabilities of his system.

Movable Furnishings

Identify all movable furnishings which must be accommodated and their intended function. Give dimensions of furnishings which will not vary; otherwise indicate the range of probable dimensions.

HVAC

Define the acceptable ranges of temperature, humidity, ventilation, and exhaust requirements. Note controls required.

Lighting

Indicate quality and quantity of light required for the space, and control requirements for the lighting; do not indicate type or location of fixtures. Note controls for other unit spaces, or controls for this unit space which are located elsewhere.

Communications/Power

Define communication and power requirements and their function in this space, except where previously noted for equipment service connection. Express location requirements in performance terms. ■

(Proceed now to 1:381, *Check List and End Tasks*).

SECTION EIGHT

CHECK LIST AND END TASKS

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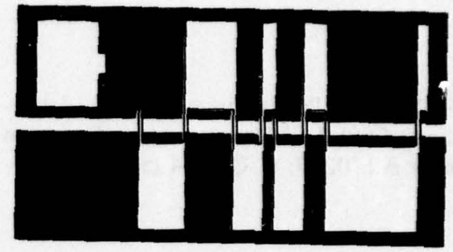
1:381 REVIEWS

After bringing the RFP/RFTP documents to 60% completion, copies should be sent to all interested parties for approval.



Installation Review

Design approval from the *Installation* may be difficult because the documents are not as definitive as those of conventional projects. The drawings for the *Fixed Design* strategy should be easily understood by *Installation* personnel. However, for the three other strategies, the design latitude being offered proposers should be explained. The users should be told why the configuration and appearance of the facilities cannot be precisely delineated at this phase of the overall process.

Division Reviews

Preliminary liaison between the District Engineers and Division auditing and engineering personnel is more important on an IBS project than on conventional projects. The Division *Audit Branch* should be forewarned that there will be changes in the documentation presented for their review.

Also, if the project is to cost more than $100,000, it is subject to "truth in negotiation" requirements—one of the considerations of the *Contract Review Board*. In addition, the *Audit Branch* should be provided with target dates for the evaluation of the bids and the award of the contract.

Likewise, the division *Engineering Branch* should be informed of some of the unique problems relating to IBS projects, in particular the problems of determining the responsiveness of some proposals to the performance in the design documentation. If the *Engineering Branch* is to take part in the evaluation process, it should be given a copy of the RFP requirements along with the intended means of judging the responses.[1]

[1]ER 10-1-3, Appendixes XIV, XV *Standard Definition of Review Responsibilities.*

1:382 ADVERTISING FOR BIDS

While the project is being reviewed by *Division* and *Installation*, the district engineer should advertise for bids.[2]

Solicitation may be accomplished through:

- mail to proposers experienced in IBS;
- public display of solicitations; and/or
- publication in appropriate trade journals.

Review of Publications

Successful bidding requires a sufficient number of responses; getting the word to potential offerers is critical. Since some proposers capable of responding to RFP/RFTPs operate only within certain regions, announcements of upcoming projects may need to utilize both national and regional journals. Listed here are major publications for possible advertising.

General Publications:

Name:	**COMMERCE BUSINESS DAILY**
Published:	**Daily**
Comment:	**Mandatory listing for government projects over $10,000.**

Name:	**DODGE REPORTS**
Published	**Daily**
Circulation:	**Regional**
Comment:	**A prime means of locating architects, general contractors and subcontractors. Subscribers receive only specific items of interest to them. (The *Dodge Bulletin* includes all items for all regions.)**

[2]ASPR 2-100 (Procurement by Formal Advertising); CERL/TIBS Data Bank, Am Com Gen Letter B-170220; USC 2304 (a), Title 10.

Addresses:

Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

McGraw-Hill Information Systems Company
330 West 42nd Street
New York, N. Y. 10036

[3]Cost of advertising in many publications will have increased since these data were collected (data shown in parenthesis with individual journal). Rates were based on a one-time appearance, one-color ad.

News Magazines of a General Nature

Name: **ENGINEERING NEWS RECORD**
Published: **Weekly**
Circulation: **112,847 (April, 1973)**
Breakdown: **Architects 3%, consulting engineers 15%, contractors 46%, construction industry manufacturers 7%.**
Cost: **$280 for ¼-page (2½" x 8")**

645 N. Michigan Avenue
Chicago, Illinois 60611

Name: **COMMERCIAL CONSTRUCTION NEWS**
Published: **Monthly**
Circulation: **45,000 (Jan. 1972)**
Cost: **$690 for ¼-page (5" x 7")**

P. O. BOX 2176 R
Morristown, N. J. 07960

Trade Journals: Housing

Name: **JOURNAL OF HOUSING**
Circulation: **15,900 (April 1973)**
Cost: **$145 for ¼-page**
Comment: **Published by the National Association of Housing and Redevelopment Officials (NAHRO).**

The Watergate Building
2600 Virginia Avenue, N.W.
Washington, D.C. 20037

Name: **APARTMENT CONSTRUCTION NEWS**
Circulation: **28,458 (April 1973)**
Breakdown: **Architects 9%, developers and contractors 74%, manufacturers 8%.**
Cost: **$395 for ¼-page (2-3/16" x 13-3/4")**

Gralla Publications
1501 Broadway
New York, N. Y. 10036

Name: **AUTOMATION IN HOUSING**[1]
Circulation: **14,620 (October 1972)**
Breakdown: **Architects and engineers 7%, manufacturers 76%**
Cost: **$308 for ¼-page**

3740 Dempster Street
Skokie, Illinois 60076

Name: **BUILDING DESIGN AND CONSTRUCTION**
Circulation: **51,286 (April 1973)**
Breakdown: **Architects and engineers 56%, package builders 19% and subcontractors 17%**
Costs: **$685 for ¼-page (3-⅜" x 4-⅞")**

5 S. Wabash Avenue
Chicago, Illinois 60603

Name: **HOUSE AND HOME**
Circulation: **42,437 (April 1973)**

McGraw-Hill, Inc.,
1221 Avenue of the Americas
New York, N. Y. 10020

[1]Now combined with *Systems Building News*; current data not available

5 S. Wabash Avenue *Chicago, Illinois 60603*	Name: **PROFESSIONAL BUILDER** Circulation: **108,747** Cost: **$215 for ¼-page (3⅜" x 4⅞") advert (April 1973)**
1957 E Street, N.W. *Washington, D.C. 20006*	Name: **CONSTRUCTOR** Circulation: **18,000 (July 1973)** Cost: **$275 for ¼-page (3-7/16" x 4-15/16")**

Trade Journals: Adm/Clr. Facilities:

612 N. Michigan Avenue *Chicago, Illinois 60611*	Name: **SCHOOL MANAGEMENT** Circulation: **44,196** Breakdown: **Architects and engineers 6%** Cost: **$370 for ¼-page (3-5/16" x 4-⅞")**

See also under *Housing*: -

- Building Design and Construction;
- Constructor

Trade Journals: Storage Facilities:

Advertising Sales Office *25 Technology Park/Atlanta* *Norcross, Georgia 30071*	Name: **INDUSTRIAL ENGINEERING** Circulation: **22,082** Cost: **$250 for ¼-page (3-7/16" x 4½")**

See also under *Housing:* -

- Building Design and Construction;
- Constructor.

See also Regional Journals, e.g. -

New York Region	Low Bidder (Associated General Contractors of America, New York State Chapter, monthly)
West Region	Daily Construction Reports
West Region	Daily Pacific Builder
Mountain Region	Daily Journal

Data Banks

A list of bidders with experience and/or involvement in IBS projects can be obtained from:

CERL-FHM
Box 4005
Champaign, Illinois 61820
Telephone: (217) 352-6511

CERL/TIBS Data Bank: CERL maintains records of architects, engineers, contractors and manufacturers with IBS experience. A listing of potential respondents for a prospective project can be supplied by CERL upon request.

BPSG Data Bank: Contains a listing of educational facilities constructed using IBS methods. Each entry supplies the name of the architect for the project. A current listing may be acquired through BPSG for a $5.00 fee.

Building Procurement Study Group
Department of Architecture
University of Illinois
Urbana, Illinois 61801

Typical Computer Printout BPSG

```
 STOCKTON STATE COLLEGE PHASE I                                     76
 ATLANTIC COUNTY
 POMONA                  NJ       8240

 OWNER:          STATE OF NEW JERSEY
*ARCHITECT:      GEDDES BRECHER QUALLS CUNNINGHAM                    52

 *******************************DESCRIPTION***************************

 BUILDING TYPE:  20/30                          DESIGNED CAPACITY: 1000

*BASEMENT   1ST FLR   2ND FLR   3RD FLR   4TH FLR   5TH FLR  TOTAL AREA
       0.    53500.    53500.        0.        0.        0.   107000.

 TYPE OF CONSTRUCTION:       NBC UNPRCT/NONC
 CEILING FIRE RATING:   UNRATED:100.   INC:  0.   1 HR:  0.   2 HR:  0.
 HVAC: MULTIZONE            SELF-CONTAINED    NATURAL GAS        A/C:100.

 *********************************COSTS*******************************
                             TOTAL               COST PER SQ FT     BID
 S/S        MFGR/SYS         COST      PER CENT   UNIT     BLDG    TAKEN

*BUILDING SYSTEM
 STR*  ROMAC MODULE        $  259260.       6.6   $ 2.42   $ 2.42   8/70
 HVC*  ITT RTMA            $  155715.       4.0   $ 0.00   $ 1.49   8/70
 L/C*  KEENE SPEC60        $  132549.       3.4   $ 1.54   $ 1.24   8/70
 DMP*  HAUSERMAN R*        $  160065.       4.1   $ 2.69   $ 1.50   9/70
 EXW*  KAWNEER/BETT        $ 1070000.      27.1   $14.46   $10.00  11/70
 CPT*  WELCO               $   65000.       1.6   $ 0.90   $ 0.61   8/70
 BUILDING SYSTEM COSTS:    $ 1846589.      46.8            $17.26

 NONSYSTEM
 OTHER BUILDING COSTS:     $ 2101969.      53.2            $19.64  11/70

 TOTAL BUILDING COST:      $ 3948558.     100.0            $36.90
 CONSTRUCTION COST:        $ 5048558.                      $47.16

 ***************************DESIGN CONSTRUCT**************************

*DESIGN/CONSTRUCT SEQUENCE:   SYSTEMS MODEL/TWO STG BID
 CONSTRUCTION MANAGEMENT:     CONSTRUCTION MANAGER

 PROJ AUTH     ARCH COMM     PRELM APP     CONS BEGN     CONS COMP
   1/70          5/70          7/70          12/70         12/71
 PROJECT DEL TIME:  19 MONTHS             *CONST TIME:  12 MONTHS

 DATE ENTERED:      10/20/72
```

1:38
Check List
05

Suggested Inclusions for the Advertisement

- Project Name
- Bid Date, Time & Place
- Proposal Number
- Issue Date
- Issuing Activity
- Work Description*
- Type of Contract*
- Bid Securities
- Bidder's Prequalification (if required)*
- Statement of Aims and Objectives*

*These items are especially important for IBS projects.

1:383 CHECK LIST OF ACTIVITIES

- ☐ Compare the characteristics of available building systems with project design requirements. Compare the parallel characteristics of the different building systems.
- ☐ Prepare Front End documentation.
- ☐ Prepare Boiler plate documentation.
- ☐ Prepare list of required technical submissions.
- ☐ Develop project requirements in prescriptive, performance, or prescriptive/performance terms, as appropriate.

Depending on the strategy selected these requirements can include:

- ☐ –site planning requirements;
- ☐ –site subsystem requirements;
- ☐ –building planning requirements;
- ☐ –building subsystem requirements;
- ☐ –functional group planning requirements;
- ☐ –unit space planning requirements
- ☐ –unit space subsystem requirements.
- ☐ Send copies of the RFP/RFTP documents for review by Installation and by Division.
- ☐ Advertise for bids for the project.

When approval is given, proceed to *Proposal and Evaluation.*

chapter four

PROPOSAL AND EVALUATION

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SECTION ONE

PROPOSAL

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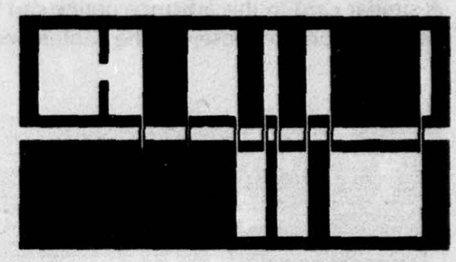
1:400 SCOPE

This section describes the initial activities before *proposal evaluation, including how to organize and conduct a pre-evaluation meeting and how to select an evaluation team. Alternative techniques of evaluation are discussed, the method depending on which procurement option was selected. The final section describes special aspects of awarding an IBS contract, as well as some military procedures which may be affected.*



1:411 PRE-BID/PRE-PROPOSAL CONFERENCE

Purposes of a pre-bid/pre-proposal conference are:

- to explain project goals;
- to review ways and means, as well as special potential for cooperation;
- to remove prejudices and fears in connection with performance specifications;
- to enlist the aid of proposers in producing well-designed facilities.

Guidelines to provide benefits from a conference

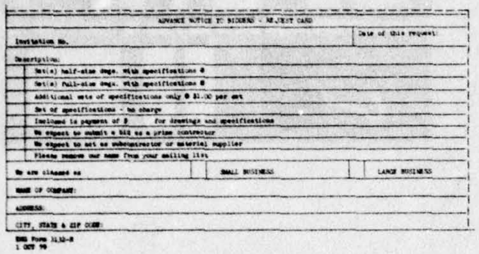
If properly conducted, a conference can help to overcome the wariness of industry and so avoid the possibility of inflated bids resulting from proposer's lack of experience with changed contractual procedures. The conference may also benefit contracting officers by revealing scheduling problems or weaknesses in the RFP/RFTP. It can provide opportunities to demonstrate the partnership aspect of the IBS approach and to identify future difficulties. Pre-bid/pre-proposal conferences are authorized as a means of briefing prospective proposers after a solicitation has been issued but before bids or proposals are completed.[1]

Logistics: Include in the notices for the conference information on its purpose, date, time and place. Also include a self-addressed reply card to help estimate the number of attendees. Although this point was mentioned in RFP/RFTP, send out special reminders requesting submission of written questions in advance to permit research for answers before meeting time.

Time: If the meeting is strictly an information exchange, allow one day (the morning with proposers and the afternoon for a "post-mortem" with Corps team, A/E's and OCE representatives). If the meeting includes industry response or discussion of addenda, allow two days (the first day with proposers, the second day for the "post-mortem").

[1]ASPR 2-207, *Two-Step*
[2]ASPR 3-504, *One-Step*

A similar card to this advance notice can be used to inform proposers of the conference:[1]



ADVANCE NOTICE TO BIDDERS - REQUEST CARD

Invitation No. | Date of this request:

Description:

- Set(s) half-size dwgs. with specifications @
- Set(s) full-size dwgs. with specifications @
- Additional sets of specifications only @ $1.00 per set
- Set of specifications - no charge
- Inclosed is payment of $ for drawings and specifications
- We expect to submit a bid as a prime contractor
- We expect to act as subcontractor or material supplier
- Please remove our name from your mailing list

We are classed as | SMALL BUSINESS | LARGE BUSINESS

NAME OF COMPANY:

ADDRESS:

CITY, STATE & ZIP CODE:

ENG Form 3132-R
1 OCT 79

[1]Excerpted from ENG Form 3132-R

Special Arrangements: Station a secretary at the entrance to the room with a register tabulated for names of attendees, the firm or organization they represent, addresses and phone numbers. Post a large sign behind the table to read "Please sign if you wish to receive a printed record of today's proceedings." Then arrange for recordings to be made for mailout.

Assemble a "panel of experts", preferably on an elevated platform facing the audience. These experts should be introduced as representing the A/E, OCE (and/or the Division Engineer), the client (*e.g.*, the Army Command) and the district project manager. Questions can then be addressed to the individuals as is appropriate.

The Meeting Place: Determine the size and location of the meeting room for preliminary responses from industry, allowing for 100% more seats than the number of invitations which have been returned. If a guided tour is required to explain site conditions, conduct this meeting at the using facility.

Content: Open with a broad statement of goals and special aspects of the project. State publicly that oral answers are not legally binding unless followed up with a printed verification from the contracting officer.

Explain the contractual, administrative and technical aspects of the RFT/RFTP, concentrating on:

- the Army's right to negotiate or to award without negotiation;
- the submissions required in the RFP/RFTP.

Follow with answers to presubmitted written questions, then request questions from the floor.

Scheduling the Date: Schedule the meeting to occur somewhere between half-way and two-thirds of the way through the proposal period.

1:412 RECEIPT OF PROPOSALS

Receipt of proposals for IBS projects varies from normal procedures:

- an initial check should see that all required submittals are included (if not, those proposals are eliminated);
- if the policy of concealing proposers' identities has been adopted, a check should see that title blocks and other identifications are deleted or obscured. All proposals should be keyed with an interim symbol for post-evaluation use. ■

SECTION TWO

EVALUATION

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1:421 THE EVALUATION PROCESS

How to Organize

Review this entire chapter to make preliminary decisions on team formation, on evaluation techniques, on scheduling, and on developing the necessary "score sheets" and other processes. Following is an outline scenario; 1:422 details the methods.[1]

Alert the *district selection board* of the date on which they may expect recommendations from the evaluation team. Establish two other groups to work concurrently:

- *one group to examine the bids (initial pricing, life-costing and other monetary aspects)*; and
- an evaluation team for all other proposal sections.

The Evaluation Team

In selecting the evaluation team, consider:

- the technical *competence of each member*,
- the contractual/administrative responsibilities each member is to be assigned.

In addition to general knowledge of conventional design and construction processes, members should be familiar with building systems products, factory fabrication, interfacing problems and life-costing. The contractual/administrative responsibilities of the various team members, should be distributed as follows:

DE – to provide leadership;

A/E – to provide expertise on responsiveness (if, in *design and documentation,* he carried the major responsibility for developing the RFP/RFTP;

OCE – to provide policy guidance;

Using Agency – to ensure that user interests are protected, reflecting concerns of master planning;

CERL – to provide an overview, based on knowledge of other IBS projects.

[1]Two documents used in turnkey work which should be among the contracting officer's references are **Engineering Circular 1180-1-114** (One-step Competitive Negotiation and Two-step Formal Advertising) and the **NAVFAC Installations book 111-01-85A** (Turnkey Processes For Family Housing Projects).

The Setting Up of Evaluation Teams

Appoint members to both evaluation teams; notify them of pre-evaluation meeting.

Receive documents and distribute proposals (both drawings and written information for cursory familiarization); forward *price schedules* to Supply Division, along with a schedule of target completion times. Arrange for a meeting space with individual desks, adequate large table tops and other needs for the pre-evaluation meeting.

The Pre-Evaluation Meeting

Identify the project; describe the unique features affecting proposal evaluations. Assign specific responsibilities to team members; distribute evaluation forms (or "score sheets") to be used. Review the standards to be observed; emphasize the importance of evaluating equally and fairly.

Recommend that proposals be categorized tentatively as "responsive", "conditional", or "non-responsive", depending on whether those proposals meet mandatory requirements.

Establish a method of obtaining and dispensing information necessary to clarify proposers' submissions. Verify the date of completing the pre-evaluation period. Ask team members to submit recommendations concerning the grading techniques used. And, if options are requested in the RFP, clarify how they are to be handled.

Evaluation: Alternative Organizational Approaches

Two alternative approaches may be used—1) a *squatters' session* and 2) Task Distribution. A *squatters' session* requires a mass meeting of the team members (which may last up to a week, or more) to identify the best proposal. This approach has advantages:

- the evaluation period may be shortened;
- all problems are discussed to facilitate a common decision;
- no additional review sessions are required;
- outside obligations do not disrupt evaluators.

Possible disadvantages are:

- if further clarification is required from proposers, the "squatter" technique may require two sessions;
- positive direction of team members is mandatory.

A *task distribution* approach requires assignment of specific parts to individual team members. If mandatory requirements have been clearly presented to the proposers, no common review sessions are required. Advantages:

- individual team members may work independently, permitting district personnel to continue their 'shopkeeping' duties;
- members are required to spend only the time necessary to evaluate their assigned proposal section (little, if any, time is then wasted on large group meetings);

Possible disadvantages:

- lack of exposure to the spirit and totality of the whole project may hamper evaluators (some systems cannot be separated and compartmentalized without destroying the overall concept and goals);
- without benefit of other people's experience, there is a likelihood of judgements being more subjective.

Evaluation Score Sheets

In order to organize systematically the information developed during the evaluation, score sheets should be provided if they were not distributed during pre-evaluation. An example of a score sheet is shown (right). Develop a second sheet to summarize board recommendations, including their recommendations for award.

The Evaluation Meeting

Receive evaluations from team members; call for problems encountered and discuss measures to be used to resolve them. Compile evaluation results obtained; call for *price schedules* from the *Supply Division*.

Total all points (if a weighted evaluation technique is used) and give all these tabulations to the district's *Selection Board* (or Contract Review Board) for analysis and recommendations.

Review results from the *Selection Board*. Plan for contract award if one "clear winner" emerges: arrange for competitive negotiations if no proposal is acceptable.

Now, for the specifics of evaluation, proceed to 1:422.

PROPOSER # ____ EVALUATION SCORE SHEET

MANDATORY REQUIREMENTS AND CERTIFICATIONS

To be classified as "responsive," all proposals must meet all Mandatory Requirements and Certifications as specified in the Design Analysis booklet page 3-122 (a part of the Proposal Package).	(check)

EVALUATION CONSIDERATIONS

evaluation consideration item number	credit allowed	credit allowed	weight factor	score
1	1-10	6	1.5	9.0
2	1-30	25	3.0	75.0
3	1-10			
4	1-20			
PROPOSER # ____ TOTAL EVALUATION SCORE				

Proposal

MANDATORY REQUIREMENTS AND CERTIFICATION

requirement categories	item no.	mandatory requirements	certification req'ed & given on page #	reqm'ts. met
SITE Building Adjacency	1	Maintain 10' setback from the project line.	P. ______	
SITE SUBSYSTEMS Grading	2	10% grade (min.) from bldg. face for 6'	P. ______	
	3	run-off ponds are provided	*	
	4	no grades over 15% slope		
Planting	5	new planting schedules are provided		
Paving	6	Government paving standards have been adhered to		
	7	Curbing details are shown on drawings		
Water, Sewer, Elect. & Commun.	8	Properly sized services	*	
BUILDING Function	9	Meets minimal floor areas	*	
etc.			* Req'd	

NOTE: All mandatory requirements must be met and checked in the appropriate box.

BY: ______________ TITLE: ______________

(Signature in ink) (Type or print)

EVALUATION CONSIDERATIONS

requirement category	Eval. item no.	response to Eval'n Consider'n number	evidence of superior solutions	credit allowed
BUILDING Function	1	1	(show that additional area is provided and where it is located)	(1-10)
Circulation	2	1&2	Design Drawings	(1-30)
BUILDING SUBSYSTEMS ROOF	3	2	(give "U" factor calculations & STC ratings certification)	(1-10)
Exterior Wall	4	3	(give "U" factor calculations & STC ratings certification) & Design Drawings	(1-20)
Etc.				

1:422 EVALUATION METHODS

This section describes evaluation methods to be used with the different procurement options—one- and two-step and competitive bidding. Prepare forms and instruct evaluators so that double standards — between this operation and the requirements of the RFP/RFTPs — are avoided.

One-Step Evaluation

The evaluation process should correspond to three submissions which make up the Technical Proposals (*i.e.*, Certification, the Proposal and the Bid). The first stage should determine whether the proposer is *responsible;* the second, whether the proposal is *responsive;* and the third, whether the *cost breakdown* conforms to the required format. If, at any one of these stages, a proposal is unacceptable, its evaluation can be terminated.

In *Stage One,* (Proposer Responsibility), tabulate certifications required in RFPs; if they are acceptable, proceed to *Stage Two.*

In *Stage Two* (Responsiveness), proposals *may* be evaluated on a number of considerations, e.g., on building function, technical performance, life costs, initial cost, esthetics, energy conservation and/or ecological criteria. To accommodate this wide range of considerations effectively, develop two tables:

1. A table on which to record and check whether each proposal responds to the *mandatory requirements;*
2. A table (or a set of check sheets) to grade or score the various *minimum standards,* as set forth in the required submissions of the RFP, and in the various specifications sections.

Mandatory Requirements: No "grades" are given for these requirements, since they primarily document the proposer's design. If the mandatory items are satisfied, the proposal is responsive. The proposals which do not include all mandatory requirements called for in the RFP are *non-responsive* and can be removed from consideration. Distribute the remaining proposals to the evaluation team. If none are responsive, resort to conventional amendments, cancellations or negotiations.

Minimum Standards: While proposals must meet minimum standards called for in the RFP, give credit — in the form of additional points — to those which exceed the minimums. The winning solution is the one accumulating the highest total score on all the criteria.[1] Special problems may involve evaluation of the building performance, of value engineering or substitutions. The most difficult task is to measure a proposed building's functional performance objectively, as it responds to specified user requirements. Assign this task to the A/E and, if possible, to a behavioral consultant as well. While the evaluation team may determine that there is clear potential for cost reduction in a Value Engineering proposal, they still have to judge that portion within the overall framework, based on whether it retains the defined quality[2].

If a proposal appears to be fairly easily modified to bring it up to acceptable standards, return it to the proposer with explicit directions on necessary changes, and include a positive notice of the required deadline for resubmission.

The certification of proposed substitutions creates problems because components may have been specially developed in response to performance specifications. If so, their compliance with the performance requirements should be ascertained through experience records, industry standards or underwriters' labels. Rely on the certification devices developed in Section 1:330 (Required Submittals).

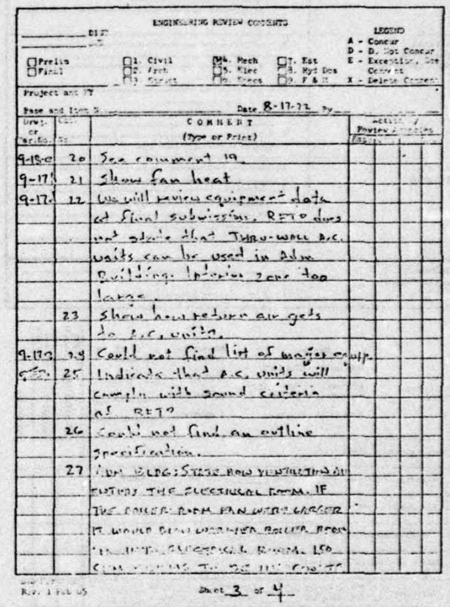
Two-Step Evaluation

Review the previous coverage of one-step, keeping in mind that cost-quality tradeoffs are not a part of the two-step procedure. Essentially, only mandatory requirements are taken into account so that evaluation is a 'go' or 'no-go' verification of the proposer's response to the RFTP requirements. Classify proposals as *responsive, conditional* (giving this group a chance to rework or supplement their proposal in order to become 'responsive'), and *non-responsive*. Notify *conditional* proposers of the exact requirements imposed upon them to enable their proposal to qualify, then set a reasonable time limit for their response. Next, request bids from all *responsive proposers*.

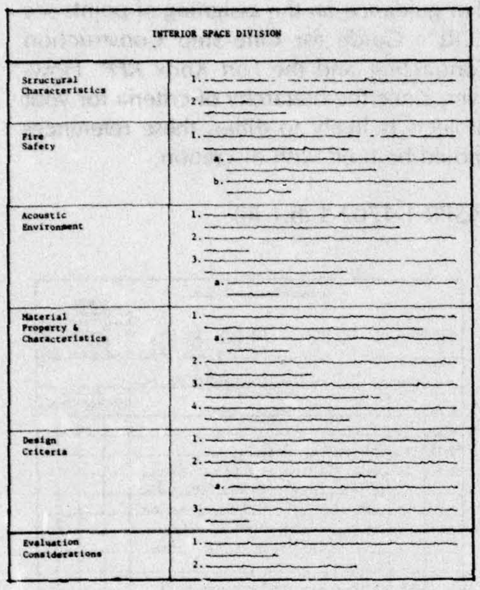
Allow late bids only in accordance with ASPR 2-203.6; then evaluate all bids in accordance with the Act of Aug. 56, 10 USC 2304 (a). Verify that only *responsive* bidders' submissions are opened; identify them on a typical abstract of bids.

[1] For guidance on the assigning of points see CERL's *Guide for One-Step Construction Contracting* and the *Fort Knox RFP*. However, since the hierarchy of criteria for your projects is likely to differ, these references should be used with discretion.

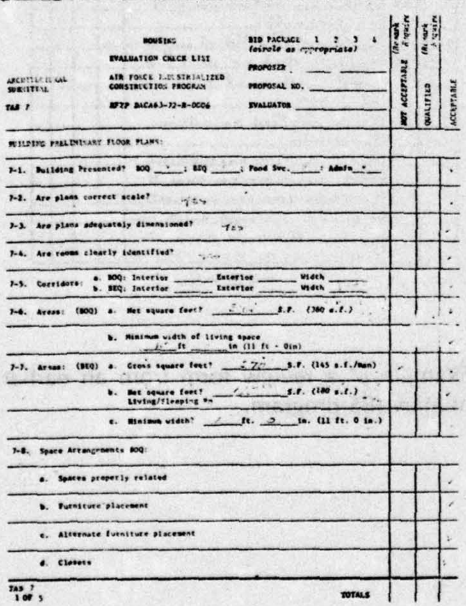
[2] ASPR 1-1702.3 (b.1 iii)



Example of a review form from an earlier military IBS program.



INTERIOR SPACE DIVISION	
Structural Characteristics	1. 2.
Fire Safety	1. a. b.
Acoustic Environment	1. 2. 3. a.
Material Property & Characteristics	1. a. 2. 3. 4.
Design Criteria	1. 2. a. 3.
Evaluation Considerations	1. 2.



HOUSING
EVALUATION CHECK LIST
ARCHITECTURAL SUBMITTAL
AIR FORCE INDUSTRIALIZED CONSTRUCTION PROGRAM
TAB 7
RFTP DACA63-72-R-0006
BID PACKAGE 1 2 3 4 (circle as appropriate)
PROPOSER
PROPOSAL NO.
EVALUATOR

	NOT ACCEPTABLE (Remark Require)	QUALIFIED (Remark Require)	ACCEPTABLE
BUILDING PRELIMINARY FLOOR PLANS:			
7-1. Building Presented? BOQ ___; BEQ ___; Food Svc. ___; Admin ___			
7-2. Are plans correct scale?			
7-3. Are plans adequately dimensioned?			
7-4. Are rooms clearly identified?			
7-5. Corridors: a. BOQ: Interior ___ Exterior ___ Width ___ b. BEQ: Interior ___ Exterior ___ Width ___			
7-6. Areas: (BOQ) a. Net square feet? ___ S.F. (360 s.f.)			
b. Minimum width of living space ___ ft ___ in (11 ft - 0in)			
7-7. Areas: (BEQ) a. Gross square feet? ___ S.F. (145 s.f./man)			
b. Net square feet? Living/Sleeping Rm ___ S.F. (180 s.f.)			
c. Minimum width? ___ ft. ___ in. (11 ft. 0 in.)			
7-8. Space Arrangements BOQ:			
a. Spaces properly related			
b. Furniture placement			
c. Alternate furniture placement			
d. Closets			
TAB 7 1 OF 5 — TOTALS			

Formal Advertising Evaluation

Since the formal advertising process does *not* request proposals but rather solicits bids for the execution or construction of a design solution, evaluation is quite limited. Bids, with their submittals, must be checked to see whether the bidder is both responsible and responsive. Responsiveness should be judged on the bidder's meeting general and special conditions such as bonding, delivery schedule, and the required equal opportunity program.

There will be *no* need to evaluate a submission unless a value engineering proposal or an "or equal" clause was used with the government's solution and the bidder responded with a substitute. An evaluation of the substitution must then determine its equality to the designated solution. This is a difficult, vulnerable technique, strictly limited in use by ASPR 1-1206.1. Given the requirements to successfully and legally execute an "or equal" clause, the One-step or Two-step option should normally be used. If however, an "or equal" clause was used with formal advertising, ASPR 1-1206 must be complied with, to determine whether the substitute equals "the salient functional features" of the designated solution. ■

Examples of evaluation sheets from earlier military IBS projects.

SECTION THREE

CHECK LIST AND END TASKS

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1:431 CONTRACT AWARD

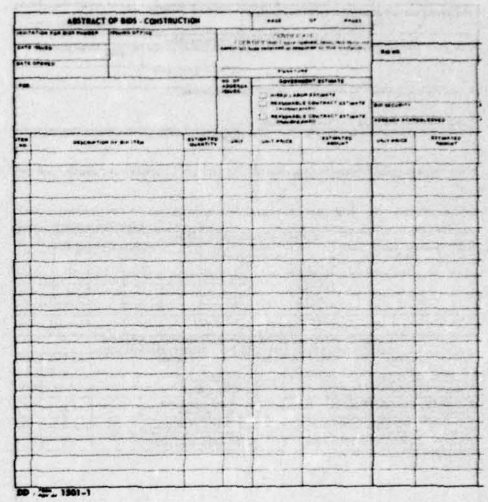
Upon receipt of bids, compile the mandatory *abstract of bids* on DD Form 1501-1, identifying bidders by name, type of product and other important information. Review finally the proposer's credentials to assure his *responsibility:*

1. To avoid possible difficulty with the Small Business Administration, check ASPR 1-705.4, 1-904.1, and 22-105 re "Certificate of Competency" before declaring a small firm non-responsible;
2. Review the bonding submissions for fiscal and management sureties;
3. If other prequalifications have not been required, request a post-qualification survey from DCASR. However, a post-qualification survey could delay the project, and since DD Form 1524 has limited coverage, the recommendations of DCASR alone cannot suffice as an adequate pre-award check.[1]
4. Carry out a plant inspection tour. The proposer's technical capability may be surveyed through such questions as:

What is his current production rate?
Have past delivery schedules been met?
Will existing work loads in the bidder's factory interfere with the project schedule?
What are the conditions of his plant facilities and his equipment?
What are his labor resources and his relations with unions (if applicable)?
What is the proposer's record of performance?
What is the proposer's record for integrity?

Contract Review Board

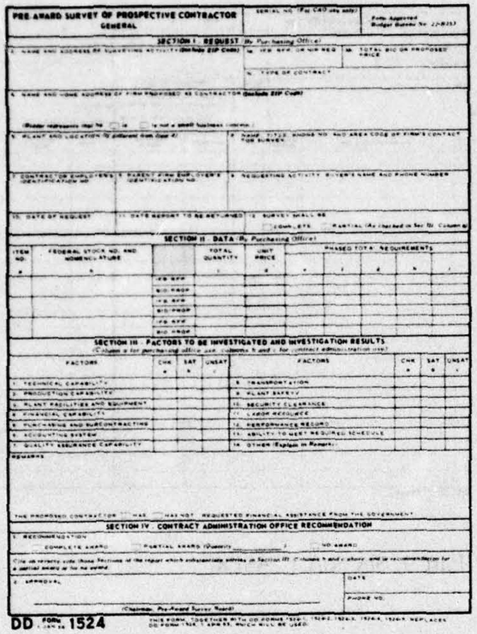
The make-up of the evaluation team may well overlap that of the contract review board; the board, acting on orders, supersedes the team, but carryover of personnel may be valuable if questions unique to the systems approach arise. Before contract award, the board should certify that funds for unique IBS contingencies (such as maintenance contracts and required spare parts) are available. Even though responsiveness has been determined by the evaluation team, 'fair and reasonable' questions may still be cause for rejection.[2] If performance and payments bonds have been delayed until after bid opening, these bonds should be received before the contract is awarded.



[1]Part 9, Section 1, ASPR.

[1]On some recent military industrialized building projects, prequalification has proven to be a hardship on proposers, adding still another required task at a crowded point on their schedule. If prequalification is not required, however, the evaluation team may be unnecessarily burdened with additional proposals.

[2]Comp Gen Decisions, p. 161, review numerical ratings, showing how awards may be made, paying more money for better quality. Also, APP 1-403.52 (d) and ASPR 1-902 (General Policy) and 1-904 (Determination of Responsibility and Non-Responsibility) provide guidance on whether a bid may be passed over.



[3] AR 313-15, par 7-26

[4] DD Form 813

[5] ASPR 7-6 (Clauses for Construction), and clause 24, (Davis Bacon Act)

[6] DD 350 for awards exceeding $10,000 with a report to the *Procurement Statistics Office;* APP 1-403.52 for awards exceeding $25,000, with notice published in *Commerce Business Daily;* GAO 1036, *Statement & Certificate of Award.*

Proposals Exceeding the Congressional Appropriation

If proposals exceed appropriations (as given in the annual Military Construction Act), there are special conditions applying to IBS projects where a waiver of the statutory limitations may be allowed:

1. If there are unique conditions imposed due to Volunteer Army developments (VOLAR), these conditions, plus their probable resulting additions in cost to the basic bid, should be submitted to ENGM-C for approval.[3]
2. If the project type is either *bachelor housing* or *storage* facilities, the design and engineering (D & E) costs may be excluded from the total allowable costs. A waiver should be requested for the amount documented by the proposer in his proposal.[4]

If these special conditions do not apply, or the resulting cost savings do not reduce the price below appropriations, plan for standard negotiations.

Separate Contract Responsibilities

Under the *Footprint* and *Sequential* strategies, the contractor for the building should be assigned major responsibility over the site contractor.

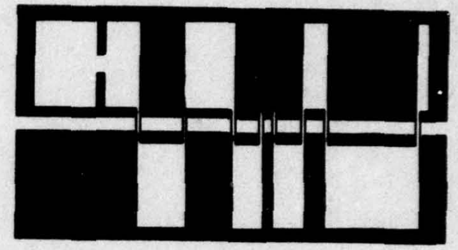
Approval of Construction Documents

The successful bidder should be required to enter into a formal contract with the Government.[5] An early date for his submission of construction documents should be set and the time when the proposer may expect approval of these documents should be stated,[6] along with his *Notice to Proceed.*

Notice of Award

A notice of award should be sent to all bidders, consisting of a tabulation of the total bids accompanied by *GSA Form 33 (Evaluation Offer and Award).* Include with the letters of rejection a notice of upcoming IBS projects to encourage future IBS response.

1:432 CHECK LIST OF ACTIVITIES



- ☐ Organize the pre-bid/pre-proposal conference.
- ☐ Receive the submitted proposals.
- ☐ Check to see that all required submissions are included.
- ☐ Where necessary, remove any identification marks on the submittals.
- ☐ Select the evaluation team.
- ☐ Organize the pre-evaluation meeting and conduct the evaluation meeting.
- ☐ Select the organizational approach to be used in the evaluation process.
- ☐ Upon receiving the bids, compile the mandatory abstract of bids.
- ☐ Review all proposers to ensure that they are responsible.
- ☐ Depending on the procurement option selected, evaluate the bids and complete the evaluation score cards.
- ☐ Gain approval from the Contract Review Board.
- ☐ Request a waiver of the statutory limitations, if required.
- ☐ Send out a notice of award to all bidders.

chapter five

CONSTRUCTION ADMINISTRATION

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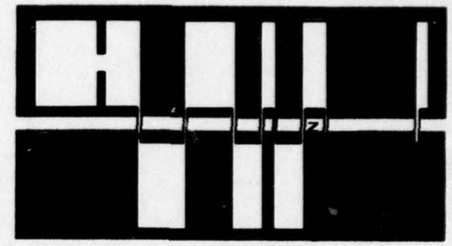
1:500 SCOPE

This chapter on **Construction Administration** describes the required activities during factory fabrication and while the building is being constructed on site. These activities include:

- the detailed scheduling of the construction work;
- the execution of quality control procedures in the factory and on site;
- the initiation of payment procedures; and
- the final "close-out" activities.



SECTION ONE

CONSTRUCTION ADMINISTRATION: SCHEDULDING

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AD-A034 131 CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAI--ETC F/G 13/13
AN INTERIM GUIDE TO INDUSTRIALIZED BUILDING SYSTEMS.(U)
JAN 76 S T LANFORD, T D CSIZMADIA, D BRYANT

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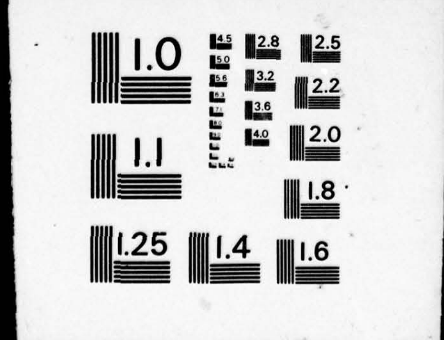


1:511 THE MAIN PHASES OF THE CONSTRUCTION PROCESS

Project management during **supervision and inspection (S & I)** may be out of the hands of the original contracting officer. The following guidelines are nevertheless provided, since IBS procedures are not parallel to standard practices. For most IBS projects, the construction phase can be divided into three stages:

Stage One:

- preparation of the contractors' construction documents;
- preliminary factory work (ordering of materials, tooling up); and
- preliminary site work (demolition, excavation).

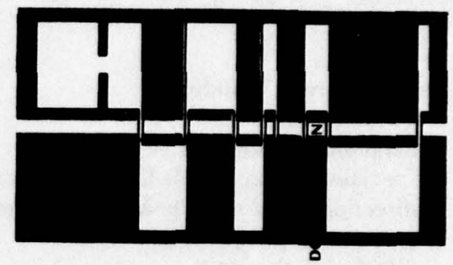
Important: These tasks can be carried on concurrently with the review of the construction documents by the District Engineer.

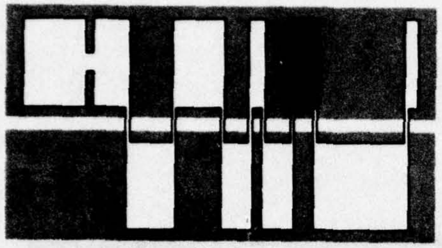
Stage Two:

- casting of foundations on site;
- installation of utility mains;
- fabrication of the components in the factory;
- shipping of the components to site;
- assembly or installation of the building system(s) on site;
- connection of utilities on site.

Stage Three:

- construction on non-system work;
- the completion of site work (paving, landscaping, exterior lighting).





Submittals may include:

- **maintenance booklets**
- **specially required tools for components**
- **directions on dissembly and relocation**
- **product certification data**
- **interfacing drawings**
- **warranties**
- **unit prices**
- **spare parts**
- **samples**

1:512 REQUIRED POST-AWARD SUBMITTALS

Since the proposals were only preliminary designs, the contractor should submit as a first priority his final design drawings. Following soon after the contract award, the review and acceptance of these drawings should not present unusual problems. If desired, the A/E consultant could be assigned this task.

The time required for document preparation depends on the project's complexity. Section 1:334 reviewed the time required for shop drawings, samples, tests and fullsize mockups. *Paper submittals should require approximately the same amount of time as with conventional* work. For three dimensional requirements (*i.e.*, samples, tests and mockups), more time should be allowed than for conventional projects because tooling-up and the assembling of subsystems involves considerable planning and execution.

1:513 NETWORK ANALYSIS SYSTEM (NAS)

If, in addition to the required CPM or PERT chart, a *Line of Balance* (LOB) network[1] was specified in the contract it can provide a basis for checking and for estimating monthly payments. It should contain a *Cumulative Delivery Schedule* and a *Unit Production Tabulation.*

1:514 COORDINATION MEETINGS

Where multiple contracts are involved, and especially where the buildings are to be assembled on a number of sites, the frequency of meetings during construction becomes more important. Depending on the complexity of the project, these meetings with the contractors should be scheduled at two-to-four week intervals.

1:515 AGGREGATED PROJECTS

If a number of projects have been aggregated into one program, the contractor should be given the freedom to schedule the work to best suit his production process. The contractor may best concentrate his efforts on one site at a time, working the sites sequentially, accomplishing a particular construction phase at one before moving to the next site to repeat the operation. ■

[1]ER 1-1-11 (Network Analysis System, 1 March 1973), a primer on CPM/PERT scheduling of contract administration, timing, financial data, process reporting and contract modification.

SECTION TWO

QUALITY

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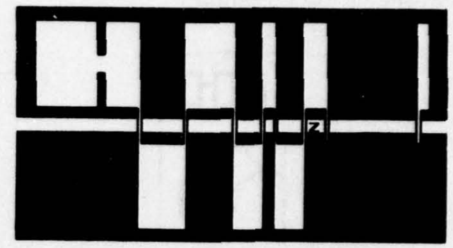


1:520 SCOPE

The approach to *quality control*[1] which should be adopted differs depending on where and how the major building components and sub-systems are fabricated. It may also depend on the types of building systems, classified according to the methods of fabrication and assembly. Three main types are:

- modular, volumetric, and light panel building systems, *fabricated in a factory remote from the project site;*
- frame and heavy panel building systems, *fabricated and assembled on site;* and
- building systems utilizing pre-engineered building components, *assembled on site.*

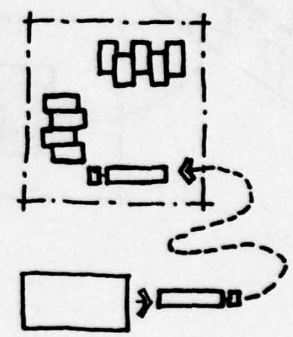
[1]ER 1180-1-6

1:521 REMOTE FACTORY ASSEMBLY

If production occurs at more than one factory, or if several sites are involved, special staffing problems may arise. Depending on the interfacing conditions, as well as when and where the Corps accepts the product (e.g., at the plant, upon arrival at the site, or as installed), the project manager may have to increase the number of his administrative personnel. If appropriate, consider DCAS for the required factory inspections.

The importance of quality control in a remote factory cannot be over-emphasized. If defective components or volumetrics are shipped to the site which then require modification or return to the factory for correction, time is lost and scheduling problems are compounded. If a major component arrives in a defective condition, pressures may result in acceptance of the component to avoid the trouble and delay involved in return shipment. To prevent such compromises, close coordination must be maintained between field representatives and factory inspectors. So that no important items go unchecked, the contracting officer should make certain ahead of time that each inspector understands his full responsibilities. The factory inspector should verify the quality of both materials and workmanship before the product leaves the factory.

Remote factory fabrication

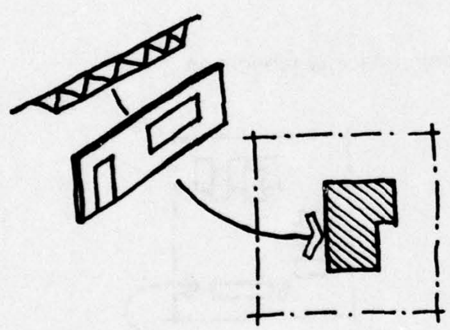


On-site factory assembly

1:522 ON-SITE FACTORY ASSEMBLY

When major components or subsystems are fabricated or assembled from smaller components in a factory established on the site, inspection is similar to conventional construction. However, the components should be inspected as they leave the assembly line rather than at the point of installation. If the major components are not assembled properly, the problem may be difficult to correct after the component or subsystem is in place. Minor components manufactured off-site should also be checked upon arrival for improper manufacture or shipment damage. To avoid damage to major assemblies or to interfacing elements, transportation and placement of the major assemblies should also be carefully monitored.

On-site assembly



1:523 ON-SITE ASSEMBLY OF COMPONENTS

Since only the building components are significantly different (e.g., pre-engineered exterior wall and roof panels in lieu of "built-in-place" walls and roofing, or perhaps plumbing trees in lieu of conventional plumbing), the inspection and quality control processes are similar to those for conventional construction. ■

SECTION THREE

PAYMENT PROCEDURES

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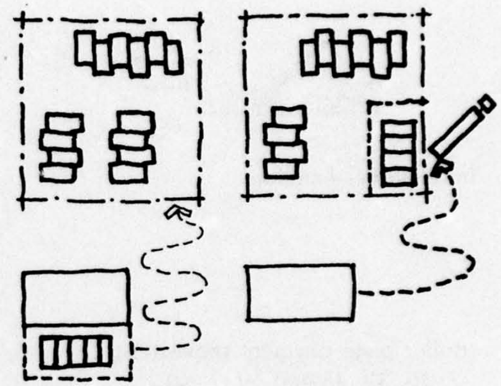
1:531 PAYMENT AUTHORIZATION

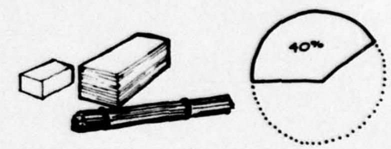
To avoid jeopardizing the fiscal base of the industrialized building contractor, payment authorizations should be arranged very early, even before site activity seems to warrant any form of payment. The contracting officer should plan to obtain proper certification and make progress payments for prepurchased materials as well as for components stored at the factory or in off-site warehousing. With industrialized building, major components (e.g., completed rooftop air conditioning units or volumetric living units) are frequently manufactured and held at the factory prior to installation at the site. Alternatively, major fabrications may be shipped to the site for holding prior to installation.

The contractor should be required to provide a breakdown of his work and the costs involved. This breakdown may include:



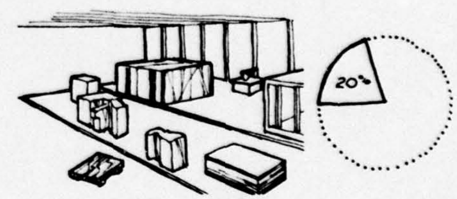
Possible Breakdown of Payments

Material types to be stored at off-site factory locations: This tabulation should be given as a percentage of the total contract price. Payment should not be authorized unless materials are properly segregated and protected.



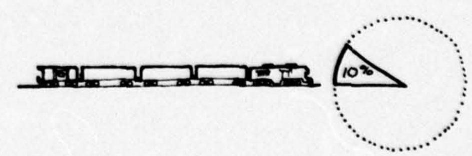
Stockpiled Raw Materials

Costs for off-site fabrication: For volumetric units fabricated off-site, the breakdown may follow the conventional breakdown—by trade. For panel systems, the breakdown would be related to how the various panels are fabricated and how the subsystems integrate—where there may be complex interfaces which would affect the amount of payments.

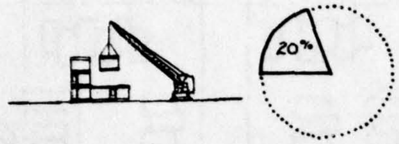


Assembly—Factory or Site

Shipping costs for major components or subsystems: This item should be considered when major subsystems are factory fabricated and stored both at the factory and on site. It also provides valuable data for estimating future project costs.



Shipping



Installation—Erection

[1]Boiler plate payment provisions; CP7, 10, 27, 30, 32, 45 and 50 (1:32)

Erection, final connection and finishing costs: These costs should reflect trade work per major component or subsystems, e.g., the amount of plumbing, electrical, HVAC, carpentry and roofing to erect and complete each volumetric.

To verify that the payment is warranted, obtain the following types of certification:

- material invoices;
- a tabulation from the contractor of completed stored units;
- payroll records for labor already expended, and/or
- an estimate of the fabrication costs as a percentage of the total installed costs.[1]

The contractor's responsibility must cover an item from the time of its acceptance at the plant, during its shipment, site storage and installation. If that item has been paid for upon fabrication, but subsequently damaged, the cost of its restoration may have to be withheld from future payments. ■

SECTION FOUR

CLOSE OUT AND CHECKLIST

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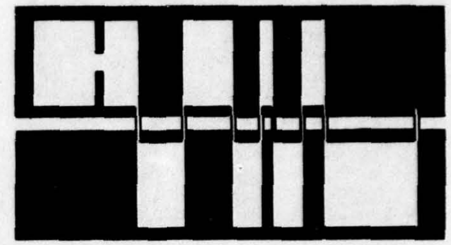
1:541 CLOSE OUT



Many final activities in the IBS design and construction process follow the conventional pattern:

- submission of certificates, guarantees and bonds;
- keys and keying schedules;
- operating instructions, spare parts lists, mechanical system balancing and instructions for maintenance personnel;
- clean-up, removal of bulletin boards and project signs.
- final inspection, punch lists, and final payment.

The phases of IBS close-out which may vary from conventional procedures include beneficial *occupancy, relocatability, multiple sites and as-built drawings.*

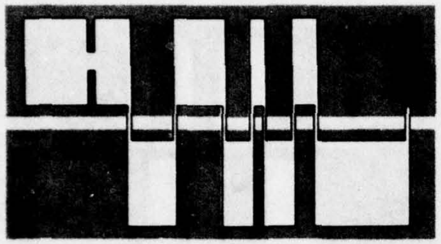
Beneficial Occupancy: Because quick occupancy may have been one of the reasons for using IBS methods, some or all of the buildings may be occupied prior to completion and acceptance of the entire project. When beneficial occupancy is taken, the contractor may be legally relieved of responsibility for loss or damage to the work, except where his own negligence can be shown. Since the warranty period for the occupied portion commences with this *beneficial occupancy date*, the status of the project should be documented at that point so that work not completed is clearly identified. This ensures that the contractor does not enter into a position of maintaining the building for the government.

Relocatability: If the building is relocatable, the contractor should be required to submit a set of instructions for efficient disassembly of the building(s).

Multiple Sites: When the program consists of a number of buildings on different sites, there are likely to be staggered completion dates. Although a single contract may have been awarded, close-out procedures should be instigated for each site in turn.

As-Built Drawings: The usual required marked-up set of prints is not sufficient for IBS projects. Since the proposer prepared the original construction drawings, he should be required to correct his tracings to *"as-built"* conditions, supplying the client with a set of "reproducibles" just prior to final inspection. Alternatively, depending on the kind of record drawings which are kept, the reproduced drawing could be 35mm microfilm on aperture cards, of blueline or blackline prints.

As with conventional practice before final payment, it should be required that all submittals are received and accepted before the project is closed out.



1:542 CHECK LIST

Check:

- ☐ Approve post-award submittals.
- ☐ Obtain a more detailed schedule of work than was submitted with proposal.
- ☐ Schedule coordination meetings with the contractors.
- ☐ Establish quality control methods.
- ☐ Arrange for early (and regular) payment authorization.
- ☐ Obtain the necessary certification for payments.
- ☐ Proceed with payments to the proposers.
- ☐ Execute close-out procedures.
- ☐ Beneficial occupancy date(s).
- ☐ Relocatability.
- ☐ Multiple sites.
- ☐ As-built drawings.

Before authorizing final payment, obtain and accept all required submittals from the proposer.

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Volume II contains supplementary information to the directives of Volume I; these data may be referenced throughout project execution.

Chapter 1 is a study of significant innovative building procurement programs which provide conclusions as to the size and type of project which will justify the use of IBS methods.

Chapter 2 tabulates certain aspects of the MCA Program procedures which

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Block 20 continued.

may asist District Engineers responsible for IBS projects.

Chapter 3 contains recommended performance levels which should be used in specifications for each type of industrialized building project. There is also a sample performance specification for a typical building subsystem.

Chapter 4 outlines information sources for IBS procurement.

Chapter 5 contains a glossary of terms, a list of acronyms and abbreviations, and an explanation of the formulae used in the Feasibility Study.

There is a two-part bibliography on IBS procurement methods, and on user needs and building design. Access to computerized information on products from a data bank maintained by CERL is explained; a list of other data banks and building research is included. In addition, there are addresses of agencies involved directly or indirectly in the development of IBS methods.

VOLUME TWO

SUPPLEMENTARY INFORMATION

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VOLUME TWO: SUMMARY

Volume Two contains supplementary information to the directives of *Volume One;* these data may be referenced throughout project execution.

Chapter One, is a study of significant innovative building procurement programs which provide conclusions as to the size and type of project which will justify the use of IBS methods.

Chapter Two, tabulates certain aspects of the MCA Program procedures which may assist District Engineers responsible for IBS projects.

Chapter Three,
contains recommended *performance* levels which should be used in spec-
sample performance specification for a typical building subsystem.

Chapter Four, outlines information sources for IBS procurement.

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chapter one

CASE STUDIES

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2:100 PROJECT SIZE

Some of the more successful IBS programs can provide guidance as to what size and type of project will justify use of IBS methods. Three factors on scope which should be considered are dollar volume, geographical dispersion, and time period for design and construction.

Aggregation of the Building Market

A common premise has been that only large contracts can realize the full benefits of industrialized building. For example, one rationale behind HUD's *Operation Breakthrough* program was that large contracts, set aside specifically for industrialized builders, would attract resources to nurture the IBS industry until it could compete on its own with the conventional construction industry. Also, since the cost of a mass-produced item normally relates to the length of its production run, unit costs would be reduced with the increase in size of the contract. Aggregation of a number of small projects was seen as the way of obtaining large contracts.

Individual building projects can be aggregated into a single contract in several ways, two of which are:

1. by grouping together a number of geographically-concentrated projects which are built over an extended period of time;
2. by grouping together a number of geographically-dispersed projects, to be built at one time.

Phased, Geographically-Concentrated Aggregation

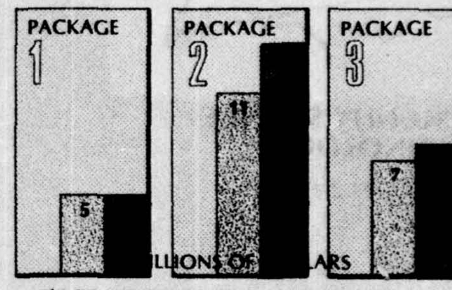
The *School Construction System Development* (SCSD) program in California is an example of phased aggregation. SCSD's administrators determined at an early stage that a large-scale order would be necessary to induce manufacturers to research, design, and develop the required products. The program comprised 13 schools which were built at a cost of $30 million. To accommodate the suppliers, the projects were deliberately spread over several years (August 1965 to September 1968). For example, the steel supplier was guaranteed that not more than three schools at any one time would require structural steel. In short, the proposers were offered a large *dollar volume*, a geographically-concentrated supply area, and continuity of demand over a period of time.

The proposers responded enthusiastically and from the results of various follow-up studies, the program can be judged as highly successful.

Simultaneous, Geographically-Dispersed Aggregation

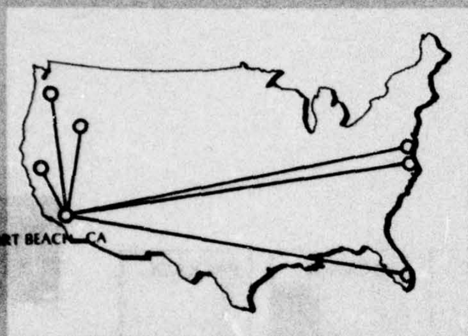
The Air Force FY72 *Industrialized Housing Program* for BOQs and BEQs consisted of four bid packages. The government estimate for the entire base bid was $23 million. Proposers had the option of bidding on three geographical sub-packages estimated at $5 million, $11 million, and $7 million. All the projects were to be built within 365 days and the building program was specified in such a way that existing building systems could be used. Proposers were thus offered a large dollar volume, a geographically-dispersed supply area, but a single year of demand (although there was the assurance of a program which would follow in FY 73).

Industry response showed that a large dollar volume does not necessarily decrease unit cost. In fact, since the bids came in at $5 million, $14 million, and $8 million, it can be concluded that the packages were larger than the optimum size. Other independent studies substantiate this conclusion. Indeed, analysis of modular and prefab housing sales show that a $22 million contract would swamp all but the largest firms. In 1971, only twenty housing manufacturers had sales over $23 million.*



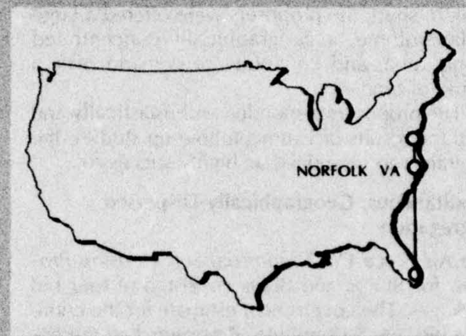
AF/1B:FY72 HOUSING PACKAGES: ESTIMATES AND BIDS

* *Professional Builder, October, 1972, p. 101.*



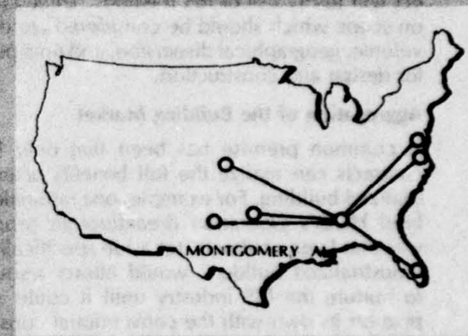
COMMUNITY SCIENCE TECHNOLOGY

Bid packages 2 and 4



THE BUSH ORGANIZATION

Bid package 2

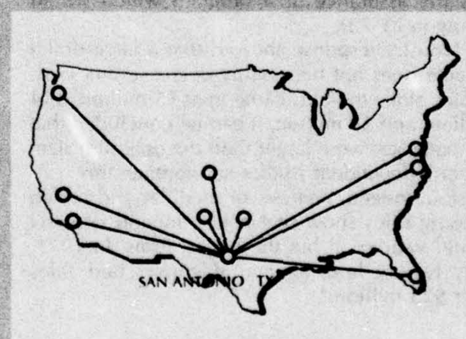


ALGERNON BLAIR

Bid packages 2 and 3

CUSTOM HOUSE BUILDINGS

Bid package 4



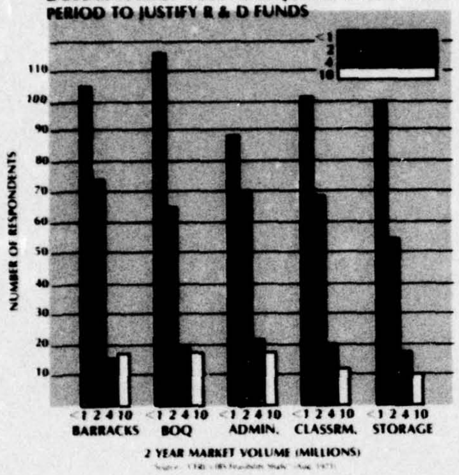
H. B. ZACHARY

Bid package 1

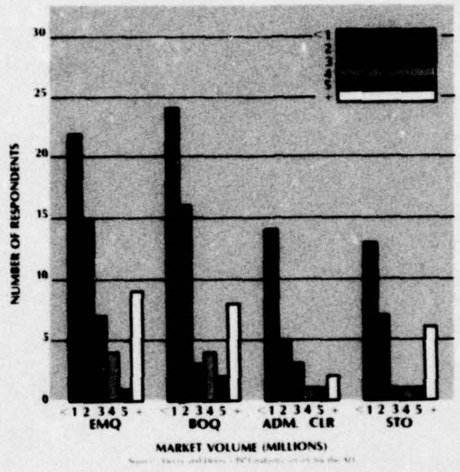
AF/IB FY72: THE RELATION OF PROPOSERS TO PROJECTS

The geographic dispersion of the Air Force *housing* projects - and industry response to those projects - is demonstrated by these maps. Each of the five proposers obviously was able to respond most readily to those projects in his part of the country.

DOLLAR MARKET VOLUME REQUIRED OVER 2 YEAR PERIOD TO JUSTIFY R & D FUNDS



DOLLAR VOLUME REQUIRED TO ATTRACT INDUSTRY



SCSD Project and the AF Program: A Comparison

The success of SCSD project and the pattern of bids on the AF program show that geographically-concentrated projects are preferable to dispersed projects. While the regional packages for the AF FY-72 program attracted several bidders, only one manufacturer bid on the nation-wide package and this single bid was much higher than the total of the lowest bids for the three sub-packages. One reason for the difference in price is the increased cost of transportation required for geographically-dispersed projects.*

* *In 1973, two rule-of-thumb cost figures were used:*
- *truck shipments, within a radius of a half-day's drive, cost $1.50/truck load mile;*
- *train shipment costs $1.00/carload mile.*

These figures can only be approximations. There will obviously be variations between volumetrics and compact shipments and between heavy concrete castings and light-weight assemblies.

Apparently, few proposers could respond because the bid package was too large relative to their production capacities. Also, each proposer was faced with the legitimate concern that if the project were cancelled, or even if he did not win a contract the next year, he would be in serious financial difficulties. It is unlikely that a proposer would consider bidding on a project if it would absorb much more than 50% of his annual production, especially with no assurance of continuing work.

Sequential aggregation (rather than simultaneous) is beneficial because it allows a manufacturer to work with a smaller investment in staff and plant. The continuity of the SCSD program likely contributed to its greater number of proposers than responded to the AF/IBS housing program. This comparison of SCSD with the AF housing project provides the following conclusions:

- a larger dollar volume is not necessary for projects using existing building systems or subsystems;
- a geographically-concentrated project is better than a geographically-dispersed project;
- continuity over a period of time is preferable to a single, large-scale project.

The 1968 federal housing legislation (Section 108) specifically provided for phasing construction over several years. For military projects, however, it has been virtually impossible to spread procurement over a period of time due to the limitations of the fiscal year frames. Only solicitations for long-range procurement *estimates* for information and planning purposes are authorized and these solicitations have to be accompanied by the clause: *"The government does not intend to award a contract on the basis of this request for a quotation or otherwise pay for the information solicited."*[1]

Multi-year procurement has formerly not been applied to military construction. For the Department of Defense and Congress to authorize such a program would require a waiver of significant fiscal year constraints.[2] Such phasing, however, has much potential for lowering costs.

[1] *ASPR 1-309 (Solicitations for Informational or Planning Purposes);*

[2] *ASPR 1-322 (Multi-year Procurement).*

SECTION ONE

SCHEDULES: EIGHT CASE STUDIES

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2:110 SCHEDULES OF PIONEERING PROGRAMS

The following two foldouts diagram procurement processes of eight significant IBS programs—two for California schools, two for Canadian schools, two for the U.S. Military, and two for U.S. Governmant agencies:

SCSD, the pioneering adm/clr program which delineated logical subsystems, spurred necessary RDTE and provided ways for open, flexible planning;

URBS, the student housing program which integrated a concrete structure with mechanical services and partitioning;

SEF, the Toronto school program which—computerized—devised a completely open system, interfacing up to five subsystems;

RAS, the Montreal school program which invited consortia to bid, and developed an electric/electronic "column"—a much-needed new component.

USAF's FY72/IBS program, which aggregated $35 million of bachelor housing, adm/clr and storage projects across the country, adding the requirement of relocatability;

U.S. Army's Fort Knox BOQ, whose documents included a "finely-tuned" evaluation section, providing an improved legal base for cost/quality trade-offs;

GSA/PBS' multi-story office building system introduced with its performance specs a matrix "locator" to relate user needs to subsystems response.

VA's hospital program developed a set of typical bays and interstitial floors which could serve as large planning cubes for design, bidding and construction.

2:111 DEVELOPMENT AND EXECUTION COMPARISONS

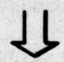
These graphic case studies review some of the more significant "process" innovations in building procurement. The pioneering programs required an extended period of time from initiation of design to occupancy. More recent projects, both public and private, have been completed in a period of one year or less. This reduction in project time— shown in the diagrams—reflects a growing knowledge of IBS methods, and that later programs profited from findings and developments of the earlier ones.

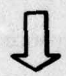
These diagrams provide a visual reference as to lengths of time involved in initiating, programming, designing and constructing facilities, and the simultaneous teamwork necessary to execute comprehensive IBS programs. They also denote principal members of the teams who accomplished them.

2:112 READING THE DIAGRAMS

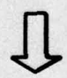
Graphic symbols include:

* events involving 1-5 parties;


an existing agency (e.g., client/owner)


an "ad hoc" or outside party, brought into the program;


a party whose involvement terminates;

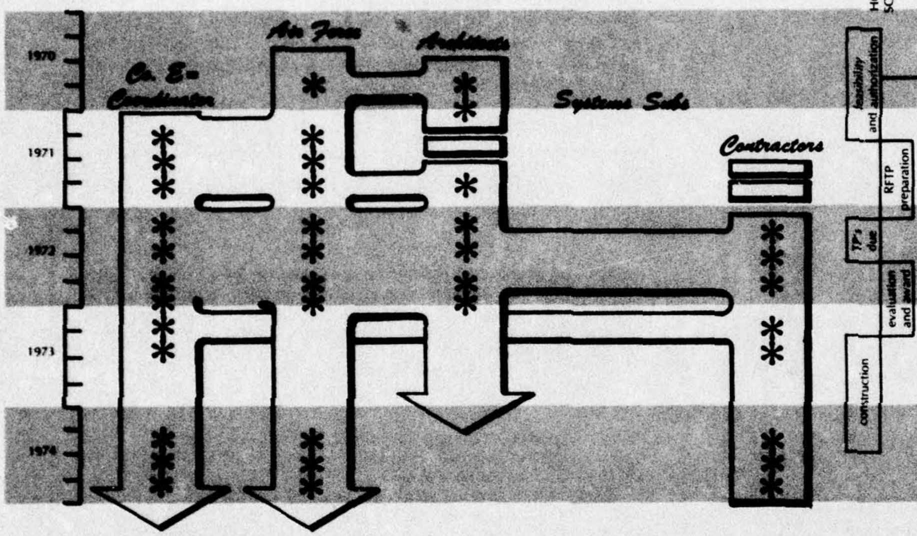

a continuing participant or program;


intermittent involvement;


participation of two or more parties in an event.

Air Force Industrialized Building

Warehousing; Housing (BOQ's, BEQ's);
Operations, Administration, Training (OATS)
Facilities (FY 1972)—All relocatable, built across the continental U.S.



Bidding procedure = two-step
Number of subsystems; open to proposer
Cost of construction: Warehousing = $9.54 per square foot
Housing = $29.92 per square foot
OAT's = $34.87 per square foot
Owner/Client: United State Air Force
Scope: 18 projects, 16 bases, 3 regions; housing for 4000 men; $35 million

OCT: AF Prospectus published with questionnaire re: industry interests; Architect contracted to study feasibility

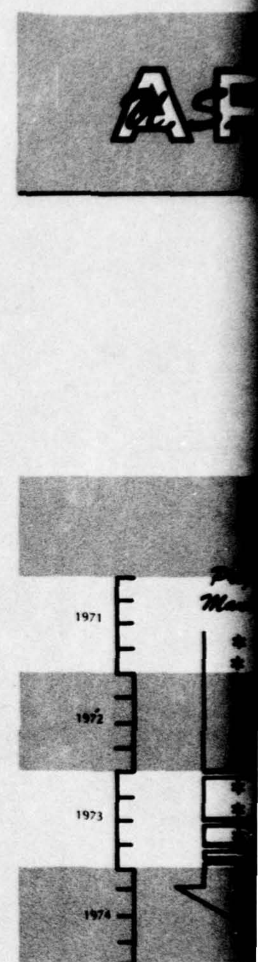
APR: DOD authorized to proceed; Corps brought in to coordinate.
JUL: Information conference
SEP: AE contract award, plant visits began

MAR: RFTP complete, Warehouse: APR: Advertise Step I
APR: Reproposal conference, Warehouse; OATS (Step I)
MAY: Advertise Housing (Step I); TP due Warehouse
AUG-SEP: TP's due, Housing and OATS Reviews; Contract awarded, Warehouse

MAR: Housing, contracts awarded, two packages
MAY: OATS contracts awarded (one nationwide) (AE retained for FY 73 program, which was cancelled)

MAR: Housing scheduled for completion
AUG: OATS completed on schedule
NOV: 1st Housing units completed and occupied

time lapse, initiation to occupancy = 3½ years



BEQ's);
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=$9.54 per square foot
29.92 per square foot
.87 per square foot
rce
gions; housing for 4000 men;

questionnaire re: industry interests;
easibility

ed; Corps brought in to coordinate.

ts began

FP: Advertise Step I
OATS (Step I)
Warehouse
ATS Reviews: Contract awarded,

two packages
ne nationwide) (AE retained for FY 73
led)

ation

and occupied

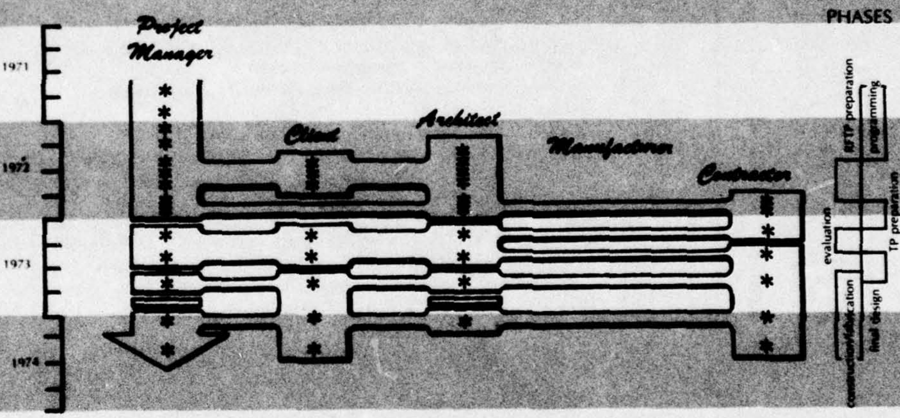
time lapse, initiation to occupancy = 3½ years

ARMY B.O.Q.

U.S. Army Bachelor Officers' Quarters

250 Motel-like units
Fort Knox, Kentucky
(See writeup, 2:121)

Bidding Procedure=one-step
Prescriptive/Performance-footprint
Cost: $32.70 per square foot
Client: U.S. Army
Scope: $3.7 million



AUG: CERL's Feasibility Study; Comp Gen allows award on criteria other than Cost NOV: Ft. Knox = ideal for IBS (OCE)
DEC: Project defined as IBS test FEB: Size reduced; AE role OK'd
APR: 1st cost estimates MAY: Programming begun
JUN: Site planning conf'c; AE retained JUL: Concept drawings
AUG: Final design SEP: Predesign conference NOV: RFP issued
DEC: Preproposal conference

MAR: Proposals received MAY: Evaluation and contract award
JUN: Preconstruction meeting; plant inspection
AUG: Contractor's design complete; construction began

JAN: Scheduled completion
JUL: Construction completed

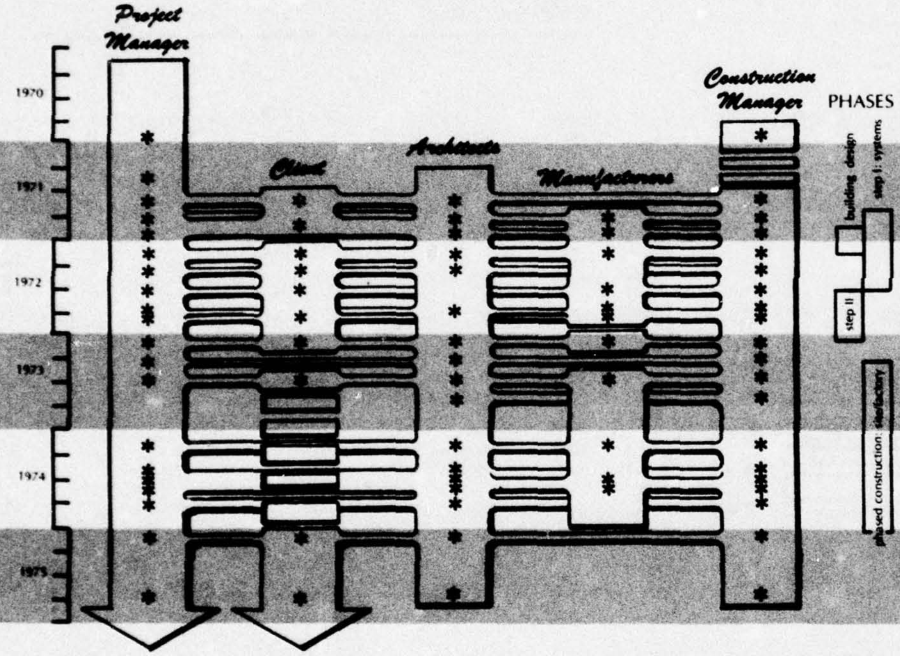
time lapse, initiation to completion=2½ years

GSA/PBS

GSA/ Public Buildings Service

Multi-Story Office Building Systems, Social Security Administration *Payment Centers* in Philadelphia, Chicago and Richmond, California (Philadelphia building schedule shown here); initiated and administered through the General Services Administration.

Bidding procedure: fast tracked, phased, 7 s's's, life-cycle costing
Scope = $31 million (1973 dollars), 600,000 s.f. (ea); 10 stories
Executing architects: Leo Daly; Nolan, Swinburne*
CM: Turner Construction
Client: Bureau of Retirement & Insurance



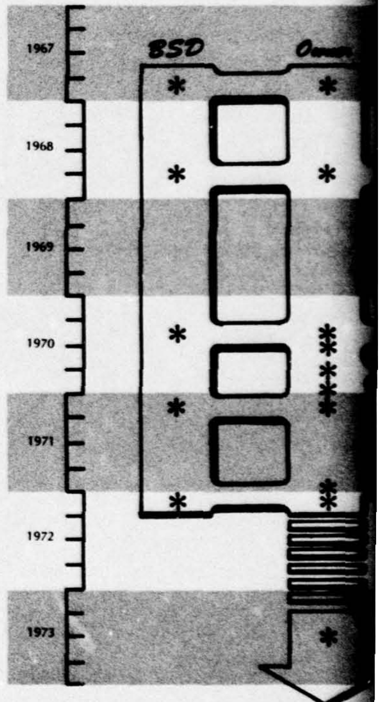
NEW BALTIMORE SSA PROJECT

JAN:	NBS' Performance Spec published; CM RFP issued
SEP:	SSA Program initiated; CM retained
NOV:	Preproposal conference #1; RFTP issued
DEC:	Regional AE's retained; scheduling network done
JAN:	Preproposal conference #2
MAR:	Preproposal conference on systems
JUN:	Drawings issued to systems offerors; AE design complete
AUG:	Site selected
OCT:	Technical proposals received on systems
JAN:	Prebid conference FEB Step II price proposals in
MAY:	Project team meeting for preliminary design approval; NTP to systems contractor; property purchased
JUL-OCT:	NTP on excavcation & caisson contracts; award HVAC, stairs, elevs, elec, plumbing, cladding, kit contracts
JAN:	Excavations and foundations completed; structure begun
MAY-JUL:	Structural frame & metal decks done, slabs cast
SEP:	Envelope & roof completed; floor/ceiling/finishes begun
NOV:	Sitework completed
MAR:	Target date for occupancy (from the beginning)
AUG:	Completion

* Deeter, Ritchey, Sippel (Philadelphia Center)
Lester B. Knight (Chicago Center)
Pereira/Bentley/Tudor (Richmond Center)

VA

Veterans' A



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ceiling/finishes begun

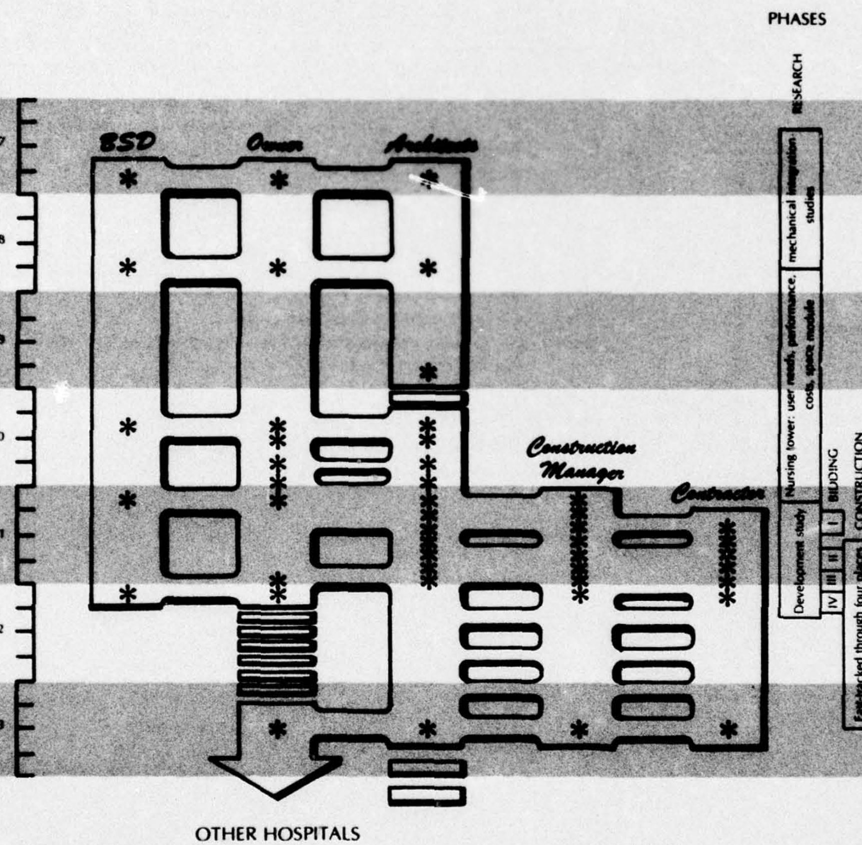
beginning)

scheduled time lapse = 3½ years

VAHOSP *Veterans' Administration Hospitals*

Laguna Hills, California
Systems features: Longspan structure
"Walk-on" ceiling
Zoned utility service space
Large building modules

Bidding Procedure = Fast-tracked, 4 phases, guaranteed maximum price
Cost of Construction = $54.00 per square foot
Owner/client: Veterans Administration
Scope: 150 beds, 195,000 square feet; $10.5 million
Architects = Stone, Marraccini and Patterson (SMP), San Francisco
Feasibility and Development Study: Building Systems Development (BSD) and (SMP)



SEP: Feasibility study contract with BSD/SMP

OCT: Mechanical subsystems research published; Second phase research also included evaluation of existing products, building prototype development, life-cycle costing, construction time comparisons, functional components, labor, recycling and feedback, as well as changes in SOP's

JUN: Saddleback Hospital authorized; final systems integration
JUL: Systems approach presented
OCT: Systems/fast-track approved
DEC: Federal guidelines established for 16% funding
FEB: CM bid documents MAR: Selection of CM
APR: Phase I docs (excavation, piers, drains) MAY: Phase I bids
JUN: Construction begun
AUG-SEP: Docs, Phase II (fdns, prestr, utils) & III (str, wndws, stairs)
NOV-DEC: Phase IV docs (mech/elec, partns, case- & sitework) and bids
JAN: Completed price established; development study published

AUG: Construction complete, 1st hospital

Research = 4+ years

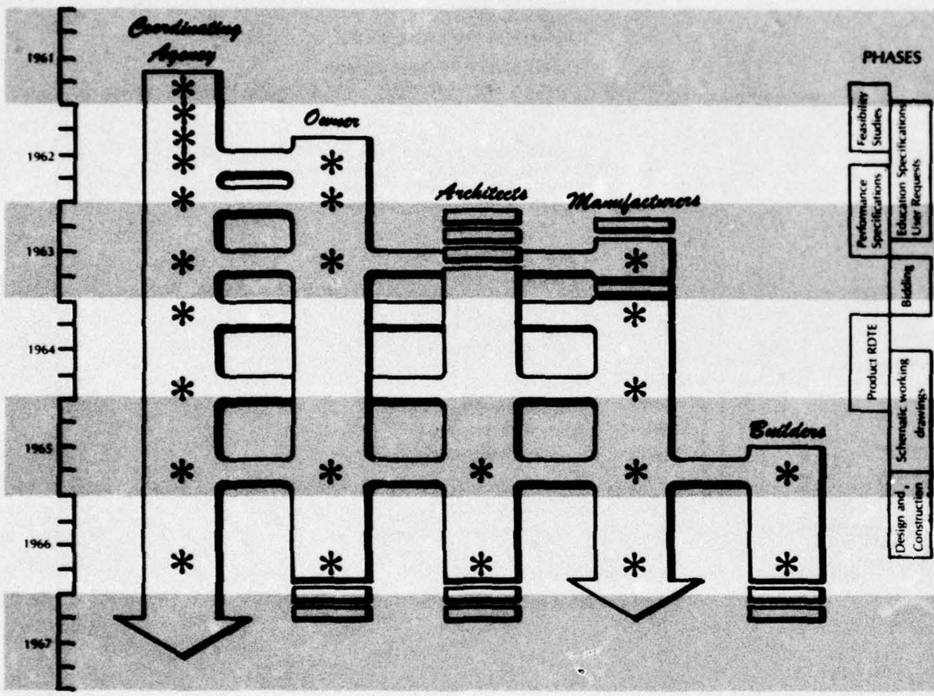
time lapse, initiation to occupancy=3+ years

7

SCSD School Construction Systems Development

- Alameda and San Diego Counties, California
- Pioneer for open systems
- Initiator of basic product RDTE, on which most school systems programs relied heavily

Bidding procedure = a form of two-step
5 sub-systems
Average cost of construction = $18.35 per square foot
Scope: 13 schools @ $30 million; 1.5 million square feet
Architects: William Blurock (and others)[1]
Client: Various California School Districts



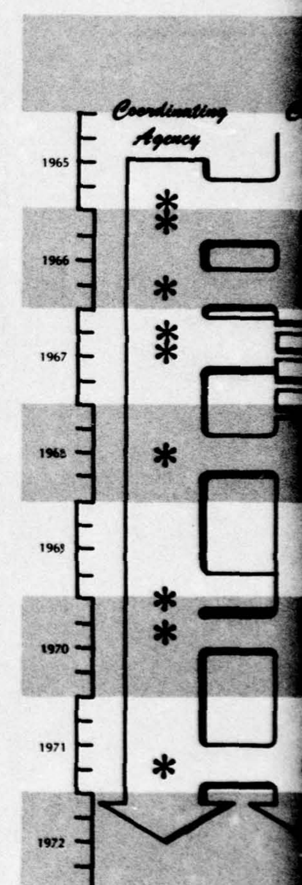
SEP:	Exploratory conference; 1st client secured
DEC:	1st funding (EFL); project architect and coordinator appointed; programming begun
JUL:	Feasibility study completed; 1st school bids committed; market analysis = R & D justified Staff added; programming virtually completed; performance specifications begun; commission established for unified bidding; 4 subsystems identified; modules established
JUL:	Pre-bid conference for manufacturers
JAN:	6 bids accepted on subsystems
FEB:	Coordination workshop
NOV:	Completion of test/pilot building
	1st school: Bertha Ronzini, Las Vegas, Nevada[2] 2nd school completed: Barrington, Illinois[2]
AUG:	1st SCSD school began construction (others began in October and November)
SEP:	1st schools occupied
OCT:	6 schools completed, others followed

time lapse, project initiation to 1st occupancy = 5 years

[1]Other architects: Leefe & Ehrenkrantz; N. Tomich; Neptum & Thomas; Stafford & Peckinpaugh; Sung & Cloyes; Kister, Wright and Wright; A. Walter; Daniel, Mann, Johnson & Mendenhall; Porter, Jensen, Porter; Gogerty & Meston

[2]These two used subsystems components developed for SCSD, but were not a part of the program

UP



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time lapse, project initiation to 1st occupancy=5 years

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Las Vegas, Nevada[2]
rington, Illinois[3]
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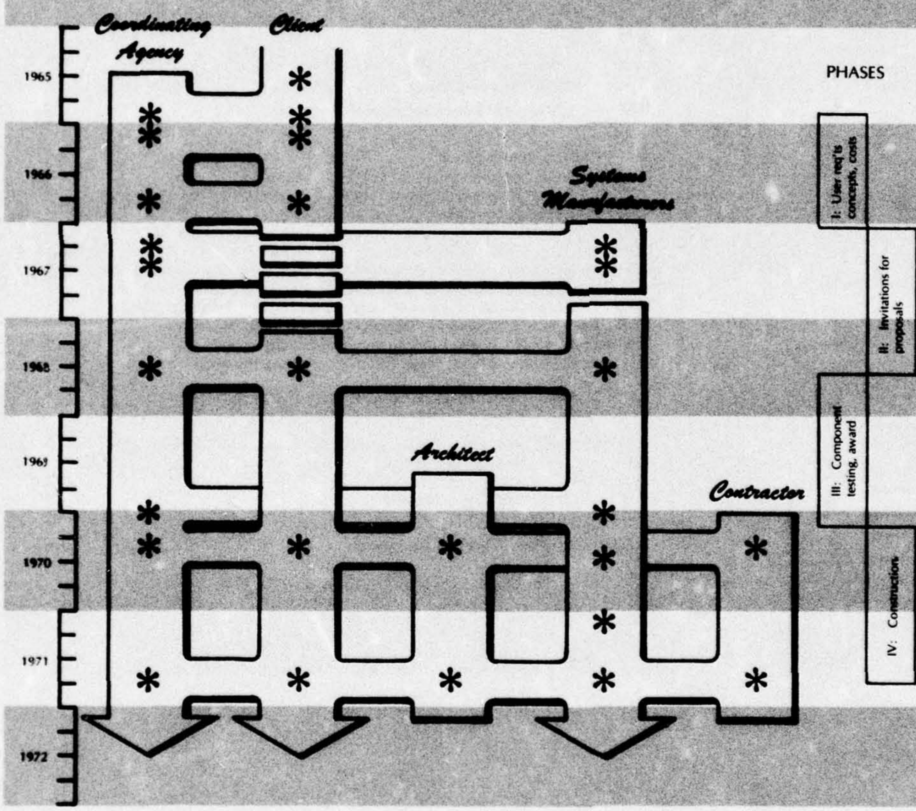
ch; Neptune & Thomas; Stafford & Peckinpaugh;
Walter, Daniel, Mann, Johnson & Mendenhall;

loped for SCSD, but were not a part of the program

URBS *University Residential Building Systems*

Coordinating Agency=Building Systems Development, Inc. (BSD, San Francisco)
A multi-story concrete structure, with integrated HVAC and partitioning

Bidding procedure = a form of two-step
3 subsystems (2 others eliminated)
Cost of construction = $29.16 per square foot
Owner-client: Board of Regents, University of California
Scope: 320 living units (cut from original 4500) @ $18.6 million (cut from $30 million)*
Architects: Dale Naegle (San Diego Residence Hall)



JUL: UC authorization, funding for feasibility studies
OCT: BSD contract, R & D begun
NOV: EFL grant, URBS established by University of California
FEB: National Advisory Committee appointed; University Residence Hall Committee liaison and cooperation established

NOV: Regents review Phase I report (BSD's feasibility study); approval for Phase II
APR: URBS' publication "Performance Specification Illustrative Information" issued with pre-bid conference
JUN: Contract documents (drawings and specifications) offered to bidders

JUL: Evaluation of bids, bidders nominated

DEC: Test building construction begun
MAY: Construction begun on Residence Hall I
JUN: Unit prices on systems due, test building completed

FEB: Original target date, complete development finalization

SEP: Construction completed, Residence Hall I (San Diego)

time lapse — initiation to occupancy=6 years

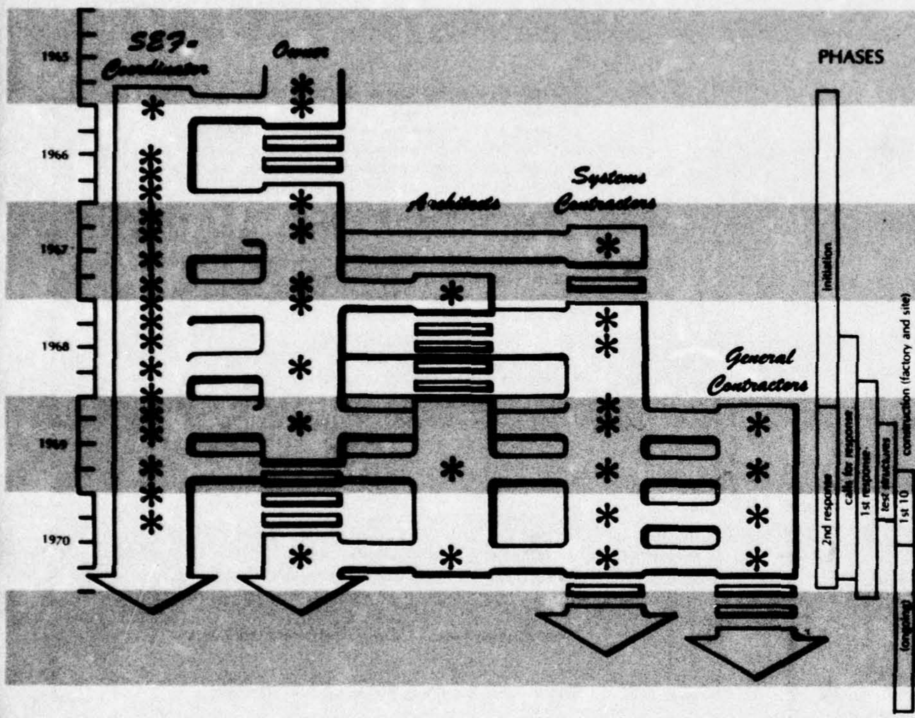
* Prospects were for 2000 units on 4 campuses (1970)

2

SEF Study of Educational Facilities

First Completely Open System for Schools
Computer-aided Systems Selection
Toronto, Ontario, Canada

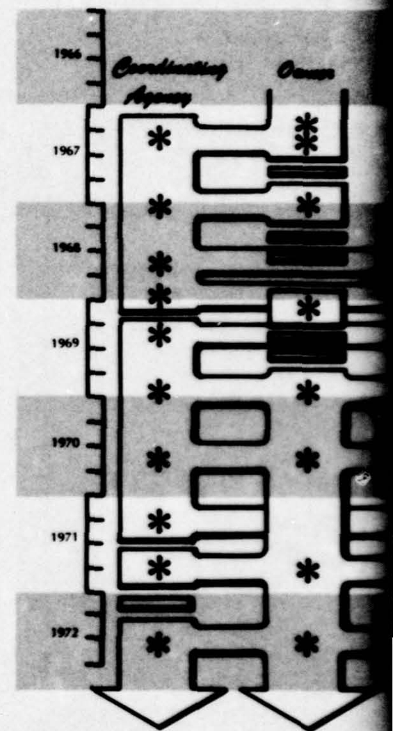
Bidding procedure=a form of two-step
10 subsystems (expanded late 1969 to 13)
Construction cost=$22.18 - $24.21 per square foot
Owner/client: Metropolitan Toronto School Board (MTSB)
Scope: 32 schools (later=25 buildings)
$28 million (cut from original $30 million)



NOV:	MTSB committed to major school study, funded by EFL + Ontario Department of Education
JAN:	Advisory committee and project staff formed
SEP:	Programming begun
NOV:	Project named "Study of Educational Facilities"
JAN:	Performance specifications begun; 21 educational/specifications groups appointed
APR:	$30 million "market" committed; open systems adopted
JUN:	Industry assures feasibility; engineers appointed
SEP-DEC:	Education specifications/user requirements issued; 1 million square feet committed = 25 schools; architects begin preliminaries
JAN-FEB:	Construction consultant appointed; 2 test schools selected
MAR-APR:	1st major conference; information documents issued
JUN-JUL:	Prequalifications, subsystems specifications issued
SEP:	Municipal amendments; DEC: 1st working drawings
JAN-FEB:	Bids for 10 subsystems received; begin catalogs
MAR-APR:	Test building GC selected; fabrication construction begun
SEP-OCT:	Test building completed; subsystem evaluated; 10 schools begun
DEC:	Subsystems catalogs issued
MAR:	2nd test building completed
AUG:	1st schools for Phase I occupied

time lapse=4½ years

RAS



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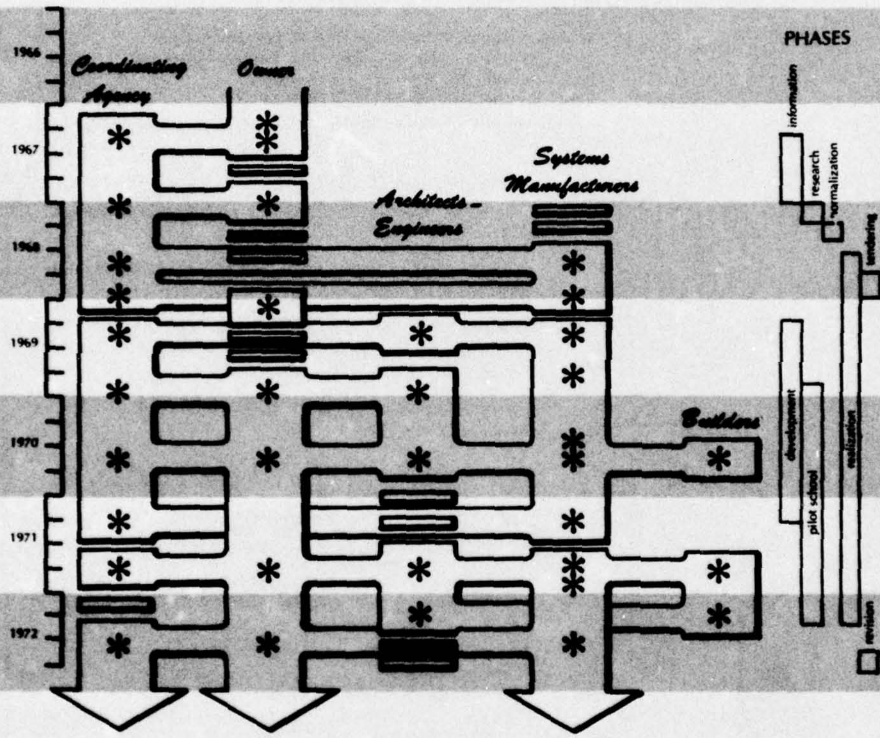
time lapse=4½ years

RAS Recherches en Amenagements Scholaries

(RESEARCH IN SCHOOL FACILITIES) + IRNES, INC., the engineering and research firm named:
Institut de Recherches et de Normalisations Economiques et Scientifiques, Inc.
Montreal, Quebec, Canada



Bidding=two-step, negotiated with teams
5 Subsystems
Construction cost: $20.34 per square foot (pilot), $18.50=subsequent average
Owner/client: Metropolitan Catholic School Commission (MCSC)
Scope: 12 Schools, $16.5 million (later to include up to 57 new and 23 additions and renovations)

APR	Initiation by MCSC
MAY:	Irnes retained, first funding by EFL
FALL	32 pedagogical committees advised
DEC-FEB:	Functions and needs defined and approved; 1st ads to manufacturers
AUG:	Pre-bid conference; performance specifications issued
NOV-APR:	Manufacturers form consortia for package bidding; market of 9 schools aggregated; 11 proposals for 5 integrated subsystems received; product testing; architects contracted
OCT:	*Full-size mockup begun*
DEC:	Pilot school design
JUN:	Full-size mockup completed
AUG:	Pilot school construction begun
APR:	Information handbook issued
SEP:	Factory fabrication begun
NOV:	Construction begun, pilot school
APR:	Construction completed
JUL:	Occupation, testing, evaluation

time lapse=5¼ years

(Terminal dates, additional schools=December 1974)

2

SECTION TWO

FORT KNOX BOQ

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2:121 AIMS AND OBJECTIVES

CERL's 1971 study of the IBS industry found that a) a majority of fabricators manufactured residential buildings; b) a significant concentration of industrialized builders existed in an area around Fort Knox; and c) a one-step procurement process was acceptable to many industrialized builders.

CERL proposed a test application of IBS techniques to DOA construction requirements. The purpose of the project was to demonstrate how these techniques could provide the type of facility desired for the Volunteer Army. OCE selected a BOQ to be acquired by the one-step procurement process and to be built at Fort Knox.

2:122 THE GENERAL APPROACH

In comparison with the Air Force's industrialized building program, the chronological sequence of events leading to the construction of the Officers' Quarters was substantially different (See Section 2:132). Also the A/E Firm carried a greater than usual share of the burden of responsibility.

In December, 1971, the Baltimore District Office (BDO) assumed responsibility for implementing the project. BDO and OCE conducted a nationwide search for a competent A/E firm having experience with industrialized building systems; Caudill, Rowlett, and Scott (CRS) of Houston, Texas, was selected. In lieu of a percentage fee, CRS was awarded a simple lump sum contract. Their work was to include preparation of performance specifications to be used to procure the BOQ, development of a one-step procurement package, evaluation of the proposers' designs, and determination of the ability of each proposing firm to meet the terms of its commitment.

CRS visited industrialized builders and identified nine companies which produced acceptable products, seven of whom produced modular buildings. Subsequent design by CRS then had a modular orientation.

In succeeding months, CRS studied the project site in detail, identifying advantageous locations for the buildings. Work also commenced on a point-rating system for proposal evaluation and performance specifications for the RFP. The evaluation process developed by the AE assigned weights to four criteria used to select the successful proposer–design, technical performance, life cost, and initial cost.

Following coordination meetings with OCE and BDO, a pre-design conference was held in the summer of 1972 to acquaint industry representatives with the proposed project.

To elicit a large response, letters were mailed to all known members of the industry, objectionable features of the RFP were rectified, and alternative site plans were developed.

In December 1972, construction funds for the project were authorized. The final RFP was issued the same day.

Six proposals were received in March, 1973, and evaluated in accordance with the point system developed by CRS. As stated in the RFP, proposers received 30% of maximum total points for design considerations, 30% for compliance with technical performance criteria, 15% for lowest life-cycle cost, and 25% for lowest initial cost.

A contract in the amount of almost $3.4 million for construction of the BOQ was awarded to *FCE-Dillon* of Akron, Ohio, in May 1973.

Construction began in August 1973.

FCE-Dillon completed construction on July 30, 1974.

2:123 POSITIVE RESULTS

This project was built in three-fourths the estimated conventional construction time and at a cost 10% below the government estimate. This was the only BOQ project constructed in that year which was within the budget.

The inclusion of life-cycle costing in this project was a substantial step forward towards evaluating projects on the basis of the total cost of the building over a period of time. The improved bases for evaluation, which includes maintenance, replacement, remodeling, and other long-range costs, laid groundwork for the military's obtaining better facilities for its investment.

Another improvement initiated in this project is the guidance given to proposers as to the relative importance of functional relationships, site amenities, esthetics, technical aspects, and costs. Knowing the weights of the various design aspects enabled the proposers to tailor their designs to emphasize the most heavily weighted. Thus, design aspects important to the Army were emphasized by the proposers, resulting in better design solutions.

2:124 PROBLEM AREAS

The limited industry response was probably a consequence of the initial decision to restrict industrialized building proposals to non-combustible systems. Wood builders constitute 65% of American industrialized building. Many wood systems judged acceptable in CERL's 1971 study and manufactured within 300 miles of Fort Knox were effectively excluded.

The participation of both OCE and BDO led to a misunderstanding on the part of the A/E as to whom he was responsible.

The lack of precedent and regulations for evaluation caused delay. Members of the evaluation

team felt that evaluation roles should be explicitly assigned during the judging of the proposals.

Evaluation using the point-weighting system proved very complicated. Life-cycle costing and esthetic considerations were especially difficult.

Standard value-engineering clauses were a source of difficulties. Subsequent to contract award, FCE Dillon proposed a different—and inferior—design which he stated could be constructed at less cost. The proposal demanded time and attention, and ultimately was rejected.

Project execution was delayed by the need to provide proposers with additional site drawings and multiple specification addenda.

Site work, including demolition required of proposers, was regarded by them as excessive.

Ideally, industrialized building eliminates seasonality. However, the unavailability of required transformers hindered winter work. While erection of the building shell was essentially completed by December 1973, power could not be supplied to heat the building. Interior finish work could not proceed because temperatures often fell below critical levels.

Finally, many certification requirements contained in the RFP required tests which were too expensive.

2:125 LESSONS LEARNED

The Fort Knox program demonstrated that proposers will respond from a distance far beyond the 300-mile limit suggested by the original CERL/IBS study.

To avoid confusion, *minimum* standard requirements should be explicitly separated from *mandatory* requirements in project RFPs.

One-step procurement can obtain quality industrialized buildings in a shorter time than can conventional processes.

Certification requirements should be kept to a minimum.

Waivers should be sought granting consideration to wood industrialized building systems in permanent facility construction.

The lead times required to produce each critical item should be determined in light of conditions existing at bid time. The Ft. Knox BOQ was originally scheduled to be built in six months. (Although unknown in advance, the lead time for procuring the required transformers was one year, making the original schedule impossible.)

Any "catering" to a segment of the industry may rule out other potentially important segments. The A/E designs were made with volumetric producers in mind, but the eventual winning proposer produced componentized buildings.

SECTION THREE

THE AIR FORCE INDUSTRIALIZED BUILDING PROGRAM

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2:131 AIMS AND OBJECTIVES

The U.S. Air Force's two-step IBS program was initiated in 1971. It sought to improve the quality within existing budgets, decrease time of design and construction, and reduce future cost through relocatability and mass production. $35 million of housing, warehousing, and operations/administrations/training (OAT) facilities (building types deemed most amenable to IBS) were aggregated into bid packages. They were to be built on 20 bases, representing one of the largest and most varied IBS undertakings in this country. The 26 original projects included 12 officer and enlisted men housing facilities (ranging from a 40-unit building to one for 996 airmen), 12 OAT facilties, and 1 warehouse, all requiring the capability of relocation at least twice within 15 years. The final program consisted of 17 projects at 16 bases.

2:132 THE GENERAL APPROACH

Establishment of contract packages

Each of the three packages was assembled according to geographic areas of the United States. The housing package was divided into three regions (eastern, central, and western); OAT facilities into two regions (eastern and western); the warehouse was a single project.

The Fort Worth District (FWD) of the Corps (to whom the program was assigned for administration) retained the Atlanta AE firm of Heery and Heery (H²) for RFTP production and to assist in TP evaluation. The two-step method of procurement was used.

The following steps were followed in the implementation of this program:

First, an industry file was formed, based on the combination of CERL's 1971 survey of the IBS industry, FWD's data bank of manufacturers, and numerous industry periodicals. In addition, H²/AF personnel manned a booth at the Fall, 1970, INBEX, collecting signatures of interested AEs, contractors, and manufacturers.

The architect hired a scheduling consultant to prepare a CPM for the entire program.

Factory visits to leading industrialized builders were made by H², FWD, and CERL personnel to assess their impact in the preparation of contract documents.

Performance specifications were substituted for prescriptive whenever feasible. To simplify and expedite this process, however, certain standards were set by listing acceptable product brand names (e.g., in the plumbing section of the RFTP, five acceptable product manufacturers were listed).

All personnel participated in two conferences for each package, lasting from one to four days, to review and edit the RFTPs.

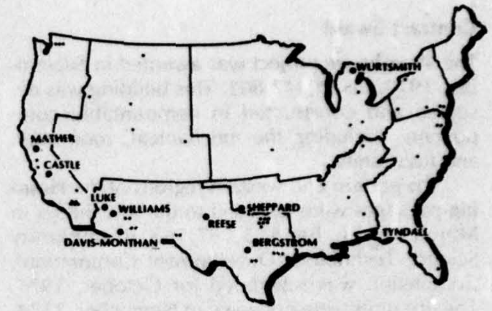
Using the combined industry tabulation derived earlier, H² sent out an advance notice for the program in January, 1972, and SWD wrote more than 1,100 potential offerors soon afterwards. Advertisements were also placed in leading industry and professional journals.

Next, RFTP documents were printed by H² and mailed to interested industry representatives. Official notification appeared in the Commerce Business Daily.

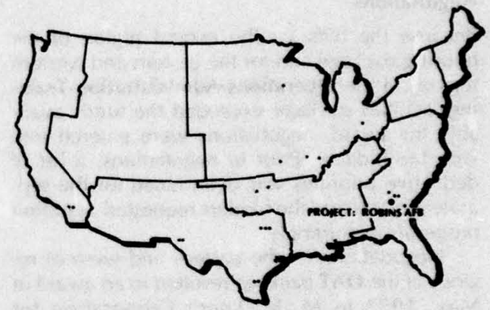
Preproposal conferences were held by FWD approximately one month after RFTP distribution.

Technical proposals were received and evaluated. Some proposals were returned for revision; those found responsive were asked to submit bids.

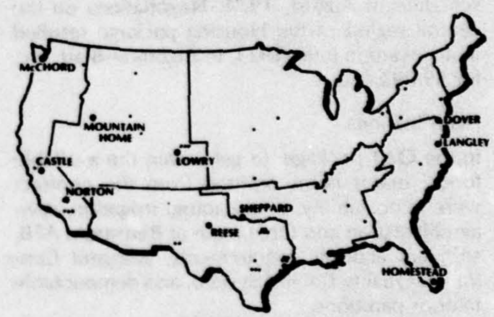
Finally, bids were received. The warehouse contract was awarded at 2.64% under the budget; the first two (of three) housing packages were 8.44% over the budget.



OATS



WARREHOUSE



HOUSING

◎ **projects**
● **request for documents**

Contract award

The **Warehouse** project was awarded in September, 1972, for $3,342,802. This building was designed and constructed in demountable components, including the mechanical, roof, wall, and floor units.

The eastern and western regions of the **Housing** packages were awarded to the low bidder in March, 1973, for $13,197,163 (Community Science Technology Development Corporation). Completion was scheduled for October, 1974. The first units were occupied in November, 1974.

Negotiations

Because the bids for the central region of the housing package and for the eastern and western regions of the **Operations-Administration-Training** facilities package exceeded the funds available for award, negotiations were entered into with the bidders. Prior to negotiations, a list of deductive priorities was determined for the separate projects and the bidders requested to submit proposals accordingly.

Negotiations on the eastern and western regions of the **OAT** package resulted in an award in May, 1973 to M. M. Sundt Corporation for $12,231,000. The project was completed on schedule in August, 1974. Negotiations on the central region of the Housing package resulted in an award in June, 1973, to Algernon-Blair, Inc. for $9,095,000.

Modifications

In the **OAT** package, to get within the available funds, major items omitted from the contract were relocatability, landscaping, irrigation, sewage lift station and force main at Bergstrom AFB, stringent acoustic requirements, stringent Contractor Quality Control System, and demountable interior partitions.

In the central region of the **Housing** package, to get within the available funds, the major items that were deducted from the contract were relocatability of the food service and administration buildings, irrigation system, stringent acoustic requirements, and stringent Contractor Quality Control System.

To further expedite the procurement of the OAT package, the contractor was permitted to submit working drawings for each project separately. This kind of "fast-tracking" decreased construction time considerably.

2:133 POSITIVE RESULTS

Relocatability

Buildings can be relocated at a later date at less cost than procuring new conventionally-constructed buildings. It is estimated that the warehouse can be relocated with a 30% savings over new facilities; the housing at a 50% savings; and the OAT buildings at a 40% savings over new buildings.

Costs

Bids were received from process-oriented industrial bidders on all six bid packages. Three of the six packages attracted bids for full scope, at or below the original budget, and were awarded. On the bid packages that were awarded, when compared with conventional military housing programs, the cost per man appears to be very favorable for the Government.

The warehouse package was $486,200 below the programmed amount. The housing package statutory cost limits were met with ease and many amenities were obtained that were not ordinarily contained in conventional designs. Bid package three, the Central Region, required negotiation; and some of these amenities had to be deleted due to the obvious under-programming of this particular area.

The construction bid prices included design and supervision costs of the contractor; and the Government actually realized design and supervision cost savings of approximately $2,500,000 for the FY-72 program, when compared to single-project program costs. The proposer's design cost is included in their bid.

Higher Quality

Of overriding importance is that many quality features have been obtained in the three awarded programs over and above what is being obtained with conventional programs and similar budgets. This was a major goal of the program and is related to important Air Force personnel policy. Positive aspects of the two housing contracts (east and west) are:

BEQ's

- Only 2 men per room (no common open barracks)
- Only 2 men per bath (no "gang" toilets)
- Smaller building complexes of residential character
- Enclosed stairs
- Relocatability
- Better quality control
- Extensive campus-like landscape with social and quiet spaces
- Tub and shower
- Individual HVAC
- Carpeting (as opposed to low-quality composition tile)
- Smoke detectors (formerly non-existent)
- Improved acoustics (shielding jet and room-to-room noise)
- Tack surface (permitting "personalizing" of spaces)
- 2 Year construction warranty (formerly one-year)
- 274 day construction (earlier occupancy)
- Wall hung W.C. (easier cleaned bath)
- Telephone, TV, P.A., intercom raceway
- High quality hardware, plumbing fixtures, and lighting fixtures

BOQ's

- 1 man per apartment (with bath, kitchen, bedroom, living room)

- Improved siting and landscaping
- More usable outside areas
- Relocatability
- Better quality control
- Tub and shower
- Individual HVAC with controls
- Carpeting
- Smoke detectors
- Improved acoustics (with decreased sound transmission)
- Smaller, more residential units
- TV, Telephone, P.A., intercom raceway
- Wall hung W.C.
- 2-year construction warranty
- Higher quality hardware, plumbing and lighting fixtures

2:134 PROBLEM AREAS

The difficulties which arose during the execution of this ambitious program may provide guidance for future IBS undertakings.

Administrative Shortcomings

The directives establishing the triumvirate for execution of the program did not clearly delineate their respective areas of responsibility. While there was tacit agreement that the Air Force would handle matters of design (both functional and esthetic), the AEs would produce the RFTP documents, and FWD would contribute to and check technical and government criteria, there was considerable overlapping and duplication of work.

An insufficient number of AF people were assigned to the administration of the program. Only two men were charged with the responsibility of protecting the client's interests, briefing Pentagon officers and members of Congress, providing the necessary liaison to bring the massive program to fruition.

Utilizing the two-step option diminished possibilities for making cost/quality tradeoffs. Moreover, with two-step bidding, no consideration could be given to a superior material, product, or process beyond that specified; the bidder who proposes something better is likely to be penalized by his reduced profits. It is practically impossile, under the two-step approach, to prepare an all-inclusive performance-type specification.

Relocatability

The relocatable feature of OATs facilities was unrealistic as set up. Had EFL-type systems been planned for, it would have been more feasible.

Scheduling Problems

The time expended in preparing the RFTP by the AE, in preparing technical proposals by contractors, and for constructing buildings, exceeded the time normally required for designing and constructing similar projects conventionally.

The time expended in reviewing technical proposals and working drawing submittals, with attendant costs, was greater than if the projects were designed conventionally. This time would have been even longer had there been a wider response by industry. In addition, costs could have escalated accordingly.

Costs

It was impossible to prepare accurate cost estimates since the AE did not know the nature of the designs to be submitted by proposers.

The aggregation of widely-scattered projects proved unwieldy. Labor costs and trade agreements, especially with non-systems work, varied significantly across the country. Several contractors could not secure adequate bonding to permit their full participation.

RFTP Constrictions

On-site factories were prohibited. While this restriction was designed to rule out "stick-builders," the decree also inadvertantly discriminated against otherwise satisfactory systems.

The mixing of buildings requiring prescriptive and performance-type documents negated the optimum use of either approach.

The RFTP was sometimes inflexible. No variation in room count whatever was allowed, forcing some manufacturers to alter their standard product line. Another requirement that bay dimensions could be *exceeded* by the offeror but not *diminished* had similar consequences. A more realistic requirement might have specified total area requirements.

A multiplicity of regulatory agencies and standards intimidated many bidders. Requiring proposers to be familiar with (or at least recognize and have access to) half a hundred such diverse resources (both government and industry), and to certify their compliance with all of them is unrealistic.

The ruling-out of highrise structures eliminated one economical form of IBS construction and precluded opening up the design for additional parking, landscaping, and other site amenities.

Industry Shortcomings

Design quality of some proposals was disappointing. A few proposals were so deficient in meeting RFTP requirements that they were considered non-responsive, and all technical proposals required modification before they could be declared responsive.

There was less than a desirable degree of competition in the actual bidding. The TPs, however, included systems for precast and prestressed concrete, steel-framed, composite, and wood, in the form of boxes, panel, and skeletal construction. A wider response would be possible if there is positive assurance of the continuation of the program and if a cooperative "give-and-take" atmosphere can be fostered and maintained.

For the housing package, all proposers except one proposed wood exteriors, which the Air Force really did not want but could not refuse. In addition, the type of wood specified—red cedar or

redwood—is the best for the intended purpose but is not readily available.

Of the many companies in the industrial construction field, only 18 firms submitted technical proposals. This was far fewer than originally anticipated. Generally, the firms which did not respond did not have the financial or production capacity to perform the work required.

About a half dozen of the largest firms in the country did not submit bids on any part of the program, although they had expressed interest prior to bid time. Studies made by the Air Force in 1970 and 1971 indicated that scores of manufacturers throughout the country were geared and ready to go into this kind of construction. However, when bids and proposals were received, it was seen that industry would not respond to the RFTPs as prepared. There were few prime contractors who were essentially fabricators of modular units.

Required Investment

Excessive bidder expense was incurred in preparing technical proposals and bids. Indications were that proposers had to spend up to $50,000 to prepare technical proposals and bids.

Contractors generally utilized the footprint as shown in the RFTP, rather than incur added costs in initiating different configurations.

Innovations hoped for from contractors did not materialize.

2:135 LESSONS LEARNED

The experiences of the AF program may aid later IBS undertakings:

Requiring *relocatability* with IBS is difficult. If included as a criterion, it should be accompanied with a definitive direction for proposers to calculate the cost of relocation, easily checked during evaluation; also, there should be a legitimate weighing system (as in one-step) to assess relocatability "plusses" against other criteria.

Only one agency should be assigned the responsibility for administering, preparing documents, evaluating proposers' submissions, and supervising construction. This centering of authority for continual execution would help assure consistency in operation policies and documents, whether the responsibility resides with a public agency (such as AFRCE) or a private AE contractor (such as H[2]).

The use of personnel schooled only in traditional building methods (relating primarily to the construction site) may be detrimental to IBS (relating more significantly to factory production), where knowledge of industrial techniques of management, scheduling, and coordination is more vital.

Administrative arrangements and decisions, especially at the formative stages of the program/project, are of paramount importance in determining failure or success. Many of the shortcomings in the responses and results were due to early administrative decisions on the part of the client or his representatives.

Conclusion

Finally, and most importantly, the AF program demonstrated that higher quality MCA facilities can be provided through the use of IBS, and that the potential exists for reduction in project time and cost. Industrialized construction shows promise, but it is still less stable and predictable than the conventional sector of the construction industry. While the Corps should continue to make use of the long-established traditional sector, it should continue to explore innovative processes.

Tabulation of Program Data

This table shows the Air Force program's schedules through bid openings, the attrition of industry response, and a comparison between government estimated costs and the "price tags" on both bids and awarded contracts.

	DATE	KIND OF DOCUMENT	NUMBER OF FIRMS	PACKAGES	NO. BIDS	GOV'T. EST. (K)	BIDS $(K) 3rd	BIDS $(K) 2nd	BIDS $(K) Low	AWARD $(K)	DATE	FIRM
HOUSING	21 MAR 72	Advance Notice	1,235	1 ENTIRE	1	23,270	–	–	42,656	–	–	–
	5 APR 72	RFTP	208	2 EAST	3	4,881	6,160	6,132	5,188	13,197 (w/package IV)	16 MAR 73	Community Science Technology
	8 AUG 72	TP	8									
	10 NOV 72	IFB	8	3 CENTRAL	2	11,162	–	16,949	13,997	9,095 (negotiated)	27 JUN 73	Algernon Blair
	1 FEB 72	Bids	8									
				4 WEST	2	7,226	–	9,099	8,133	13,197 (w/package II)	16 MAR 73	Community Science Technology
OATS	3 APR 72	Advance Notice	1,235	1 ENTIRE	1	11,802	–	–	16,752	12,231 (negotiated)	15 MAY 73	M. M. Sundt Constr. Co.
	24 APR 72	RFDP	118									
	14 SEP 72	TP	3	2 EAST	1	6,992	–	–	9,303	–	–	–
	12 DEC 72	IFB	2	3 WEST	1	4,310	–	–	6,712	–	–	–
	8 FEB 73	Bids	2									
WAREHOUSE	19 JAN 72	Advance Notice	1,168		4	–	3,943	3,446	3,343	3,343	29 SEP 72	MPC VanWinkle
	14 MAR 72	RFTP	93									
	15 MAY 72	TP	6									
	14 JUL 72	IFB	4									
	6 SEP 72	Bids	4									

chapter two

MILITARY PROCEDURES AND INDUSTRIALIZED BUILDING

TABLE OF CONTENTS

SECTION ONE

MCA PROGRAM PROCEDURES

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2:211 NOTES ON AR 415-15

In this subsection, we give notes on the implications of AR 415-15 on the use of industrialized building methods.

ARMY REGULATION NO 415-15

*AR 415-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 28 June 1975

CONSTRUCTION

MCA PROGRAM DEVELOPMENT

Effective 1 July 1975

This is complete revision of AR 415-15 and changes are made throughout. Local limited supplementation of this regulation is permitted, but is not required. If supplements are issued, Army Staff agencies and major commands will furnish one copy of each to HQDA (DAEN-MCP-A) WASH, DC 20314; other commands will furnish one copy of each to the next higher headquarters.

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CHAPTER 3

PROGRAMING POLICIES AND PROCEDURES

3-1. General. This chapter covers MCA programing policies in general and explains various special requirements and considerations.

a. Construction programs are formulated by commands and their instal-

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reported to the major Army commanders for integration into subsequent year programs with appropriate updating of information and command priorities.

b. Designs and cost estimates must provide for complete and usable facilities, or usable increments, without the need for subsequent additions or embellishments through use of other funds with adequate consideration having been given to life cycle costs as required by DOD 4270.1-M. **For specific limitations on use of other funds for construction, see AR 415-25, AR 415-35 and AR 420-10.**

Note A: *With industrialized building methods, the pertinent data may be information on user needs, design schematics and performance criteria. Also, OCE's Design Guides and Project Development Booklets may set minimum standards. In addition, CERL's cost estimating process can provide budget figures.*

c. Construction projects not in excess of $50,000 funded cost will

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able facilities of the DA, DOD, other Federal agencies, State and local government agencies and commercial establishments. Necessary approvals will also be obtained for removal or relocation of existing useable facilities in accordance with AR 420-70.

e. Proposed construction projects not sited in accordance with master plan components approved by DA (AR 210-20) will be shown and described in DA approved revisions to these components, prior to project inclusion in the short range construction program.

Note B: *Where projects fall within previously approved plans and do not obstruct utilities or traffic paths, they should not require a revised submission. Be sure footprint and other RFP/RFTP requirements observe the General Site Plan or that approval for any variations are granted*

f. Cost of interior and exterior permanent signs to identify new facilities or areas having constant or fixed usage will be included in

(b) At nonpermanent installations, permanent construction may be programed only if the nature of the requirement is such that permanent construction is the only type feasible or economical.

(c) Semipermanent or temporary construction, **as deemed appropriate by a realistic assessment of the duration of the need**, will be used to satisfy current requirements for which permanent construction is not authorized or is inappropriate.

Note C: EFL - type components (as described in the FIXED DESIGN STRATEGY) can be fairly readily rearranged to accommodate changing needs. Relocatable facilities, on the other hand, have met with mixed success (see 2:131).

(2) Allowable space criteria.

(a) Space criteria are prescribed in DOD 4270.1-M and TM 5-800-1.

Note D: Standard modular buildings may exceed allowable space criteria, but may require a waiver. With the one-step procurement option, the proposer may receive additional points if the product is within the required limits.

(b) The criteria for permanent and semipermanent construction does not envision separate buildings for each requirement. Fewer and larger buildings and more **multipurpose buildings are needed to house Army functions efficiently.** Design of facilities to an unnecessarily high degree of specialization is undesireable because future alteration to meet new or changing missions is very expensive. (See DOD 4270.1-M and TM 5-800-1.)

Note E: Design criteria required by the District are mostly based on standards established in existing documents. Special criteria not covered by the standards must be provided by the installation. Fort Worth District has developed a form for use in obtaining this information. See also Note C.

(3) Strength basis.

(a) For determining permanent construction requirements, use the long range strength shown for each installation in the "Army Stationing

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(b) For determining semipermanent and temporary construction requirements, use the current strength and adjusted to indicate approved and scheduled activations, inactivations and redevelopments.

h. Urgent construction requirements which qualify may be processed as the need develops, under the provisions of paragraph 3-20 AR 415-35

Note F: Industrialized building projects can almost certainly provide facilities in shorter time than conventional projects.

i. At all active installations and at those inactive installations which are being maintained to fulfill Army mobilization requirements, the costs of any capital improvements required for joint use of the Active

j. Design of all major construction projects, except those overseas which have been designated as the responsibility of one of the overseas commanders or the **Naval Facility Command will be accomplished by the Chief of Engineers.** Using services will furnish firm criteria (e.g., designation of units and functions, functional capacities, special features, detailed requirements and relationships and recommended siting) to field offices of appropriate construction services, so as to minimize changes, delays and additional cost. In all cases, using services will furnish firm criteria to the appropriate construction service field office before the project is inserted in the SRCP. **Development and up-dating of fuctional requirements is to be in accordance** with AR 415-20. Feasibility studies, when required to support any project will be accomplished by using services prior to including such project in the short range construction program. Using services will prepare DD Forms 1391 with emphasis on developing projects with adequate scopes and the best possible cost estimates using procedures detailed in AR 415-17. Budgetary estimate data will be prepared and submitted as provided in AR 415-20, paragraph 5b. Review **of concept designs by using services will be in accordance with AR 415-20.** After design has begun, changes in criteria or siting will be limited to those which clearly justify the additional costs and delays involved. **Resiting of facilities, after the original site has been approved, requires** Department of the Army approval before redesign is initiated. When ever feasible, compatible functions will be

Note G: *For industrialized building projects, reviews at the concept stage may be on performance criteria and rough schematics. Final design or more definitive drawings are not available until proposals have been submitted. A 'fixed design' strategy would, however, permit more conventional reviews. (See Notes on AR 415-20, Section 2:213).*

Note H: *This caveat is modified because: 1) the design stage may occur later than usual because the proposers prepare the detailed design-tailoring their products to RFP/RFTP's, 2) it is more difficult for users to make changes after the RFP/RFTP's have been issued-since addenda are involved, and 3) administering industrialized building projects has, on some military programs, cost less than on conventional projects.*

Final design and construction will be limited to the scope justified during hearings before the Secretary of Defense, **the Office of Management and Budget,** and the **Congress.** The scope of any project will not be increased merely to take advantage of bids which are less than budget estimates.

Note I: *In evaluating one-step proposals, unsolicited features cannot be 'rewarded', though additional points may be given for projects which exceed (rather than merely satisfy) specified performance criteria. Proposers know the budget allocations; therefore word the RFP/RFTP's to encourage the best solution for the available money and use deductions if necessary.*

k. Overruns in the total cost limitations (station authorization) for work to be undertaken at **each installation will not exceed the percentages stipulated by law.** The cost estimate for each project approved by the Congressional Armed Services Committees is not a separate cost limitation. However, contracts will not be awarded without prior approval of the Department of the Army on any project within the station authorization of the Military Construction Act for the fiscal year. **Deferral of projects to cover cost overruns on other projects requires** the approval of the Secretary of Defense.

Note J: *Before evaluating One-step proposals for technical adequacy eliminate all proposals that would result in a cost overrun exceeding the station total or the percentage stipulated by law.*

2:212 NOTES ON THE INTERACTIONS OF AR 415-20 AND IBS

The following notes highlight specific portions of AR 415-20 which may assist or hinder various IBS processes, along with suggestions on successfully meshing the processes and the regulation.

*AR 415-20

ARMY REGULATION
No. 415-20

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 28 March 1974

CONSTRUCTION

PROJECT DEVELOPMENT AND DESIGN APPROVAL

Effective 15 May 1974

This is a major revision of AR 415-20 and changes are made throughout. Local limited supplementation of this regulation is permitted, but not required. If supplements are issued, Army Staff agencies and major Army commands will furnish one copy of each to HQDA(DAEN-MCP-A) WASH DC 20314; other commands will furnish one copy of each to the next higher headquarters.

1. Purpose and scope. This regulation applies throughout the Army and defines procedures and responsibilities of the various Department of the Army elements as they pertain to the design of facilities proposed or authorized for inclusion in Military Construction, Army (MCA) programs. These procedures will not apply to programs for family housing (AR 210-50), minor construction (AR 415-35) and the Army Reserve Components (AR 135-6).

2. Responsibility. Design of Department of the Army facilities is the responsibility of the Chief of Engineers (AR 10-5), except work assigned to a construction commander or other agency listed in paragraph 2-3, AR 415-10 as exceptions to the Chief of Engineers authority and responsibility for construction. Using services functions related to design approvals are delineated herein. In addition to the performance of the construction mission as set forth in AR 415-10, the Chief of Engineers ~~will~~ :

a. Develop, maintain and promulgate architectural and engineering design policy and criteria for Department of the Army facilities or construction projects.

b. Direct architectural and engineering surveys of existing facilities as required.

c. Design Department of the Army facilities (AR 10-5). In cases where design and construction responsibility is assigned to a construction service other than the Corps of Engineers, the provisions in this regulation applicable to district engineers are equally applicable to the construction service field office of the designated construction commander or other agency.

d. Develop and make available standard plans and/or uniform criteria and specifications for facilities with appropriate consideration of cost economy.

3. Explanation of terms. For the purpose of this regulation the terms shown below apply. Other terms are listed in AR 415-10 and also apply to this regulation.

a. Design. The orderly architectural and engineering processes by which requirements for and criteria governing a proposed facility are translated into project drawings, specifications, analyses and cost estimates.

b. Service representatives.

(1) The using service as defined in AR 415-10 is responsible for establishing facility requirements. For medical facilities (Facilities Category 500), The Surgeon General will represent the using service. In all other cases not otherwise prescribed by Army regulations, the representa-

***This regulation supersedes AR 415-20, 20 February 1969.**

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Note A: *When preparing or reviewing PDB-I, be sure that building requirements are stated in performance terms as much as possible. Check especially section 7, PDB-I.*

Note B: *The drawings and data should be considered design criteria rather than a specific design for a building. Note on each drawing: "Functional relationships, physical dimensions, materials and methods of construction are given here to provide guidance for design. Technical data defines minimum standards, and there is no intention to rule out industrialized systems or their components."*

Also, optional acceptable concepts may be prepared to convey to proposers the freedom they have in preparing the detailed design. (CERL's Industrialized Building Potential Use Study, Vol. 3).

tive of the using service will be the installation commander. The installation commander will be responsible to insure timely and complete coordination of all matters with the tenant commander for projects pertaining to tenant facilities.

(2) The construction service for Army facilities is the Corps of Engineers except as otherwise indicated in paragraph 2. In most cases, the responsibility for specific projects will be delegated to the district engineer in charge of the construction service field office executing design and construction work; therefore, for purposes of this regulation, the terms "district engineer" and "construction service field office" will be considered synonymous.

c. Facilities.

(1) *Facility.* A building, structure, or other real property improvement.

(2) *Primary facility.* (See Block 20, DD Form 1391 shown in AR 415–15.) The main facility or facility complex required to perform an essential mission or function.

(3) *Supporting facilities.* (See Block 21, DD Form 1391 shown in AR 415–15.) Supporting facilities include outside utility services and site work to support primary facilities. Supporting facilities include electric service, water, sewer, steam, gas, grading, planting, sidewalks, roads, streets, parking areas and other similar work necessary to provide common support service to multiple facilities in the area. Except for items otherwise stipulated by directive or criteria, the supporting facilities to serve a specific project will extend from a point five feet outside the facility building line to points of connection with networks common to other facilities in the area.

d. Nonrepetitive type facilities. Those facilities for which standard designs or existing suitable designs are not available and for which new project designs must be prepared.

e. Repetitive type facilities. Facilities which may constructed at many installations (such as barracks, tactical equipment shops, dental clinics, etc.) and for which standard designs or previously prepared designs are available and are directed for site adaptation.

f. Programs. Terms regarding programs, such as Short Range Construction Program (SRCP), Intermediate Range Construction Program (IRCP), and Five Year Defense Program (FYDP) are as prescribed in AR 415–15.

g. Budget data. Data prepared by the using service to indicate functional requirements to substantiate estimated costs. The data are for use by DA in determining funding needs. (See para 5*b* for detailed requirements.)

h. Project Development Brochure (PDB). The PDB is a document utilized to establish project requirements. It will be prepared in two parts. Part I will delineate "functional requirements" of the using service. Part II will delineate "design criteria requirements" of the construction service. Preparation of the PDB will be accomplished in accordance with provisions of TM 5–800–3. Part I will be prepared by the using service. When Part I is complete, the using service will obtain approval of higher authority and will furnish an approved copy to the construction service field office. Part II will be prepared by the construction service field office upon receipt of direction from the Chief of Engineers. The coordination of interfaces between Part I and Part II will be done by the construction service field office.

i. Pre-concept control data. Data prepared by the construction service field office to reflect preliminary concepts indicating construction requirements and substantiating the estimated cost of the project. The data are for DA use during the budget hearings before congressional committees. (See para 5*d* for detailed requirements.)

j. Concept design. Drawings and data developed prior to the initiation of final design, for the purpose of defining the functional aspects of a facility and providing a firm basis on which the district engineer can initiate final design. These include—

(1) An area site plan for building groups.

(2) A project site plan.

(3) Floorplans showing functional layout; the scale will be such as to permit an entire floorplan to be drawn on one sheet.

(4) Typical cross-sections showing floor to floor height.

(5) Elevations indicating principal exterior materials to be used.

(6) An outline of materials and methods of construction with a schedule of typical finishes.

(7) Communications systems requirements, to include a statement reflecting coordination of such requirements with the local communication-electronics officer.

(8) A design narrative discussion to reflect types of heating, ventilating and air conditioning systems considered with a description of the system selected for the facility.

(9) Cost estimates of the primary facility and supporting facilities. Electrical, mechanical and structural aspects will not be developed beyond basic determinations except in those cases where they have particular importance related to the specific function for which the facility is intended. Requirements in addition to the above may be directed by the Chief of Engineers for specific projects. For medical projects, TM 5-838-2.

k. Final design. A complete set of drawings for a project, accompanied by appropriate specifications and design analyses and cost estimates covering all architectural and engineering details. This design is used to obtain construction bids and to serve as contract documents.

4. Coordination and management.

a. Coordination of effort. Effectiveness in project development and design management is dependent on close coordination between the using service and the construction service. Effective communication between the construction service district engineer and the using service facilities engineer is particularly important in the project development phase. A flow chart delineating the sequence of events in the development and design of a typical Army project is shown in the appendix.

b. Nonrepetitive facilities.

(1) Designs of nonrepetitive facilities will be managed by the Chief of Engineers through a designated district engineer who will perform the work by contract with a private architect-engineer firm or through use of government forces, as appropriate. Since requirements development is the responsibility of the using service, normally the district engineer will not become directly involved. If, however, the using service desires support in requirement development, the district engineer will provide assistance using funds supplied by the using service.

(2) Project site plans will be prepared by the district engineer to conform to Department of the Army criteria and policies and approved master plans, and to meet performance requirements of the using service not contrary to such criteria and policy and approved master plans. Proposed construction projects which are not sited in accordance with approved general site plans (AR 210-20 and AR 415-15) will not be approved for design initiation until the Chief of Engineers has approved a revision which encompasses the proposed construction.

c. Repetitive facilities.

(1) Standard designs will be prepared under the supervision of the Chief of Engineers. The district engineer will be responsible for obtaining functional requirements and appropriate approvals from using services.

(2) Project site plans for repetitive facilities will be prepared and approved as previously described in *b*(2), above for nonrepetitive facilities.

d. Advertising for bids and construction contract award. Upon completion of final design and receipt of appropriate directive from the Chief of Engineers, the district engineer will furnish to the using service and the installation commander a copy of all bidding documents along with a notice that the district engineer intends to advertise the project for bids within a specified time. Comments by using services on final design or bidding documents will not be permitted to delay advertisement and award unless they pertain to a mission change.

5. Project development and design execution, nonrepetitive facilities. Basic steps to be followed in the development, execution, and approval of projects for nonrepetitive facilities are as follows:

a. Development of functional requirements. The using service is responsible for developing and approving functional requirements on which the design of any given line item will be based. Primarily, this involves the preparation of Part I of the PDB, prepared in accordance with requirements of TM 5-800-3; it will include an outline of project requirements and source data, the preparation of functional flow diagrams, the delineation of facility performance, space requirements, security requirements, and other data relevant to the functional and operational requirements of the facility. Additionally, it involves the provision of firm information on the location of the facility at the installation, on the special siting approval required for explosive facilities, and on any special equipment requirements. Development of functional requirements by the using service should start as soon as the need for a project is recognized, and will be completed no later than the time it is first inserted in the SRCP. In some instances it

Note C: *With IBS final design is a two-stage process, consisting of the preparation of the RFP/RFTP by the Corps and the development of the Technical Proposal by industry.*

Note D: *The functional requirements must be much more specific than with conventional projects, since these data form the bases for the RFP preparation (See CERL's Industrialized Building Potential Use Study, op.cit.; Heery & Heery's RFTP's for Housing, Warehousing and OATS, Division B).*

Military IB

Note E: *If FHA or other specifications are being used in order to be compatible with "off-the-shelf-systems" so note at this time.*

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may be necessary or desirable for feasibility studies to be prepared by technical experts outside the organization of the using service in advance of the development of functional requirements. Usually, such studies will be prepared under the direction of the district engineer acting for and using funds provided by the using service.

b. Budgetary estimate data. Budgetary estimate data will be prepared by the using service, and along with DD Form 1391 will be furnished to HQDA(DAEN-MCP-B) WASH DC 20314, for all projects included in the command SRCP. These data will include a general site plan, and in some cases, a detail site plan and a budgetary estimate, as follows:

(1) For a proposed facility sited in accordance with DA approved master plan documents, a copy of the General Site Plan (as referred to in AR 415-15) annotated to show the location of the proposed primary facility and related supporting facilities will be furnished to OCE. The general site plan will show the location and orientation of each building and all major related supporting facilities to be constructed under the project (see para 3c(3) for definition of supporting facilities). For those projects not sited in accordance with DA approved master plan documents, the submission of Detail Site Plan will also be necessary as provided in AR 415-15. Both the General and Detail Site Plans will be marked HQDA(DAEN-MCE-P) WASH DC 20314.

(2) The budgetary estimate will contain only essential data to support and supplement the information shown in Blocks 19 through 22 of DD Form 1391. Information to supplement entries in Block 19 should amplify "work to be done" with a concise description of construction requirements and **delineate any intended deviations from DA criteria.** Unless deviations are indicated, it will be assumed that Corps of Engineers Guide Specifications for Military Construction will apply. **In developing budgetary data to support entrees** in Blocks 20, 21 and 22, techniques shown in AR 415-17 will be used. Step by step procedural guidance is provided in appendix A of AR 415-17. Estimates that deviate from the norm of appendix A, AR 415-17 must be justified in detail. Techniques shown in appendix B of AR 415-17 should be used when there are deviations in unit cost which are more than five percent above or below the factored unit cost of the norm. The step-by-step preparation of budgetary estimates will be reproduced on 8" x 12½" paper and be attached to (and in back of) the DD Form 1391 copy for "DAEN-MCE-S" required by paragraph 6 of AR 415-17. Reproductions of "work sheets" to 8" x 12½" size will normally suffice. A copy of all data submitted to DA for DAEN-MCE-S and DAEN-MCP-B will be furnished *to the supporting district engineer* for information. The following statement will appear on each set of budgetary estimate data submitted: "Approved for Conformance With Using Service Requirements in Accordance with AR 415-20," and signed by an authorized representative of the using service. When the representative of the using service is not the installation commander the data *will also contain* the following statement: "Approved for Conformance With Installation Requirements in Accordance with AR 415-20," signed by an authorized representative of the installation commander.

c. Subsequent Mission Changes. If at any time it becomes apparent to the using service that the mission for which the facility is being designed has been changed to the extent that the design would require extensive revision, the using service will immediately furnish the district engineer a statement of the change of mission and guidance for changing, deferring or cancelling the project.

d. Pre-concept control data. Pre-concept control data will be prepared by the district engineer upon receipt of direction from the Chief of Engineers and will be forwarded to HQDA (DAEN-MCE-S) WASH DC 20314, in August as shown on the chart in the appendix. These data are prepared and submitted on a time schedule independent of that specified for other data required by this regulation. Pre-concept control data are required for all projects authorized for inclusion in the SRCP and are used to substantiate the estimated cost and otherwise support the project when presented to congressional committees for program funding. Pre-concept control data will be based on requirements established in Parts I and II of the PDB, on judgments made after acquisition and evaluation of essential engineering field data, and on subsequent concept design to the extent that it has been accomplished. All pre-concept control data will be prepared by the construction service field office on 8" x 12½" sheets,

with drawing scales kept as small as possible, consistent with legibility, so all information can be presented on a minimum number of sheets. These data are preliminary in nature, and no more detail than called for below should be displayed. The intention is to use existing information as much as possible, and reproduction of existing data for display on 8" x 12½" sheets will be acceptable. Pre-concept control data will include a project site plan, outline specifications, a building outline plan, and a control estimate, as follows:

(1) *Project site plan.* The pre-concept project site plan will show the location and orientation of each building in the specific project and all related supporting facilities to be constructed under the project (see para 3c(3) for definition of supporting facilities).

(2) *Outline specifications.* If Corps of Engineers Guide Specifications for Military Construction are used, the pre-concept outline specifications will then consist of a concise description of construction along with a commitment that COE Guide Specifications will be used. If the Corps of Engineers Guide Specifications for Military Construction are not used, the pre-concept outline specifications will consist of a concise description of construction along with a complete listing of applicable guide specifications together with delineation of all intended deviations from **Department of the Army criteria.**

(3) *Building outline plan.* The building outline plan will indicate the dimensions of each building, its anticipated configuration at ground level elevation, the number of floors and the total gross area. **In order to minimize the number of sheets of pre**-concept control data, the building outline plan may be shown on the same sheet with the outline specifications if space permits.

(4) *Control estimate.* The pre-concept control estimate will be based on engineering instructions contained in the directive authorizing preparation **of pre-concept documents.**

e. Concept design. Concept design will be prepared by the district engineer upon receipt of direction from the Chief of Engineers. **It will be based on detailed functional requirements** supplied by the using service in Part I of the PDB and on pre-concept control data prepared by the district engineer. Additionally, when the project has been approved by the Department of the Army for inclusion in a fiscal year program or has been included in a Public Law, concept designs will be based on data contained in Department of the Army approved DD Forms 1391 and any supplement**ary instructions provided by the Chief of Engineers.** At all times during the preparation of concept design, the using service is encouraged to provide comments and constructive criticism concerning both functional and technical aspects of the facility. **Concept design will be limited to the Department** of the Army approved scope and funding or to the scope and funding approved by the Congress should congressional action on the project be completed before concept design is initiated. Concept design normally will be limited to no more than 25 percent of total design, with the exception that for medical facilities the provisions of TM 5-838-2 will govern. When concept design is finished, the district engineer will submit the drawings and data to the representative of the using service at the installation level for approval. The using service will be allowed 2 weeks to approve or request changes and to obtain all necessary concurrences, including the concurrent approval of the installation commander where the using service is a tenant on an installation. If changes are necessary, they will be made by the district engineer and the revised design again submitted. When a concept design is approved by the using service and the host (where applicable) at the installation level, this will normally constitute final approval of concept design, and when transmitted in writing to the district engineer, will constitute the basis for final design. For certain complex, high priority projects, the using service may choose to retain concept design approval authority at a level higher than the installation, and should so notify the district engineer when transmitting to him the approved PDB (Part I). The concept review period for such cases may be extended by the district engineer to a maximum of 4 weeks. For certain types of projects, such as medical facilities, concept approval is vested in the Office of the Secretary of Defense. For these projects, submittal of concept designs will be made by the Chief of Engineers. An approved concept design will not be revised without the written consent of the final approving authority. Changes to approved concept designs may be made only to meet changed operational requirements or bona fide state-of-the-art advances, or to revise ap-

Note F: *These drawings should not restrict the proposers from making improvements or changes in order to accommodate their building design within the budget figure. Note on each drawing: "Room areas, gross areas, overall building dimensions and description of construction are given here to substantiate cost estimates."*

Note G: *While the site design may require conceptual definition, drawings defining buildings may be more in the nature of "character sketches", relating more to physiological needs and functional relationships than physical needs. (See CRS Ft. Knox Concept Phase Report. Table 1 design).*

Note H: *If Using Service representatives are part of the review teams (for either the one-step or two-step options), the A/E's should be directed to demonstrate how the potential benefits of IBS methods are made possible by their concept.*

Note I: *If a project is likely to receive approval through the MCA cycle, a waiver to omit concept design may be granted by OCE upon request. The Using Service review–normally carried out–would then be moved to the RFTP review.*

proved concepts found to be incompatible with sound engineering practice.

f. Final design. Final design will be prepared under the supervision of the district engineer upon receipt of direction from the Chief of Engineers. It will be based upon and be consistent with previously approved concept design. Final design will not require approval by the using service except in specific instances where special design review procedures are prescribed by regulations, such as those in AR 385-60, *Coordination with Armed Services Explosives Safety Board* and AR 190-13, *Physical Security,* or have been requested in writing by the using service and approved by the Chief of Engineers. However, for informal review and assurance that all approved concept design requirements have been met, the district engineer will provide opportunity for in-process review of design documents by the using service at some point near completion of final design. In addition, copies of all completed design specifications will be furnished the using service as indicated in paragraph 4*d*. District engineer approval of final design is sufficient to permit the project to proceed to advertisement for bids and eventual construction contract award following receipt of appropriate directives from the Chief of Engineers.

6. Project development and design execution, repetitive facilities. Basic steps to be followed in the development, execution and approval of projects for repetitive facilities are as follows:

a. Development of functional requirements. Development of functional requirements for repetitive facilities will be the same as the requirements for nonrepetitive facilities, as delineated in paragraph 5*a*.

b. Budgetary estimate data. Data requirements for repetitive facilities will be the same as the requirements for nonrepetitive facilities, as delineated in paragraph 5*b*.

c. Pre-concept control data. Data requirements for repetitive facilities will be the same as for nonrepetitive facilities, as delineated in paragraph 5*d*.

d. Concept design. Requirements of paragraph 5*e* apply equally to repetitive facilities except that effort will be made to minimize engineering and design costs, and to maintain uniformity of construction throughout the Army, by use of the following techniques:

(1) For those projects for which the use of Standard Designs is directed by DA, concept designs will include project site plans plus appropriate sheets of the Standard Designs to show floorplans, elevations and sections.

(2) For those repetitive projects for which a field-prepared design will be site adapted, concept designs will include project site plan plus appropriate sheets from the previously prepared design to be site adapted.

e. Final design. Final design for repetitive facilities will follow the same procedures as previously noted in paragraph 5*f* for nonrepetitive facilities except that effort will be made to minimize engineering and design costs, and to maintain uniformity throughout the Army by use of standard designs or by site adapting previously prepared designs.

7. Using service approval authority. To avoid delay and effect economy, commanders having programing authority for Military Construction, to the fullest extent practicable and subject to the restrictions of this regulation, will delegate to installation and comparable level representatives the authority to deal with district engineers in the development of budgetary estimate data, PDB's, pre-concept control data, concept designs and final designs.

8. Economy. Facilities will be designed to meet the functional and operational requirements of the using services following the design principles set forth in DOD 4270.1-M, Construction Criteria Manual.

2:213 MCA PROGRAM PROCEDURES: A SUMMARY

In the following tables, information is summarized on MCA Program Procedures. This information should be of particular interest to District Engineers responsible for industrialized building projects.

MCA PROJECT PROCEDURE	FORM	PREPARATION BY	SUBMITTED BY	SUBMITTED TO	VIA
Installation Long-Range Construction Program	DA 726 726a Ref: AR 415-15	Installation	Major Command	Dept. of Army	Command Channels
Command Intermediate-Range Construction Program	DA 726 (Annotated for 6 year period) Ref: AR 415-15	Installation	Major Command	Chief Engrs. (DAEN-MC)	Command Channels
Command Short-Range Construction Program	DA 2530-R	Installation	Major Command	Chief Engrs. (DAEN-MC)	Command Channels
Installation Construction Program	DA 1390	Installation	Major Command	Chief Engrs. (DAEN-MC)	Command
Military Construction Line Item Data	DA 1391 DA 3086	Installation	Major Command	Chief Engrs. (DAEN-MC	District Division Command
Projects Recommended for Preliminary Design (Concept Design)	Corps of Eng. Operating Program (CEOP) (Machine listing)	Chief of Engr.	Chief of Engr.	District	Install'n Division

TARGET DATES	ACTION TAKEN BY	REMARKS	POSSIBLE WAIVERS OR ALTERNATES FOR IBS
31 Jan or upon request	Chief of Engr.	+Installations and Major Command will list by priority the top 10%. +Should reflect Master Plan and Army Stationing and Instl. Plan +District to help in preparation	
10 Nov annually	Chief of Engrs.	+Includes annotations of priorities for all construction requirements during the six year period	
15 Feb FY-2	Chief of Engrs.	+In accordance with intermediate Range Program, Policy changes, or previous year slippages +1 year plan	
15 Feb FY-2	Chief of Engrs.	+Accompanies Short Range Program +Listed in accordance with Major Command priorities	
15 Jan	Review by: +Sec'y Defense +Bur. Budget +Armed Service Appropriation Priorities by Construction Requirements	+Preliminary submission to CONARC for review in September. +Must have District cost concurrence before submission to Major Command (around Aug.) +Decisions are made affecting building construction and material selections	Urgent Requirements: forward 1391 to Dep. Chief of Staff for Logistics (Const. Div.) at time of need. Emergency MCA.
May FY 2	District	+Includes design instructions and degree of design to be done. +CEOP normally authorizes concept design, budget sketches, outline specs and cost estimates.	

MCA PROJECT PROCEDURE	FORM	PREPARATION BY	SUBMITTED BY	SUBMITTED TO	VIA
Budget Sketches and Budget Estimate	DA 3086	District	District	Chief Engr.	
Preliminary Design (Concept Design)	In accord w/ AR 215-20 +Drawings +Outline Spec +Design Analysis	District: +in-house or +A-E	district	Commander at next higher level in installation chain of command. (3 wks.)	Install'n for initial approval or changes (2 wks.)
Updated Cost Estimate	DA 3086	District		Chief Engr.	
	DA 1391 (Cont'd)				

TARGET DATES	ACTION TAKEN BY	REMARKS	POSSIBLE WAIVERS OR ALTERNATES FOR IBS
1 June FY-2	Used to substantiate estimates for Congressional hearings	+Sincle line drawings. +Authorized by the CEOP. +Must be approved or conformance with Using Service Requirements. +IB: requirement for a 'plan' may not be appropriate at this phase.	+Sketch not required if a standard design is used. +CERL's cost process needed in lieu of quantity survey since drawings for IBS are less definitive at this stage.
31 Oct FY-1 (Normally takes 90 days)	Review by: +District (A-E) +Division +Command +User District holds until final design authority	+25% of total design is max. allowed. +District reviews A-E design Division reviews in-house des. +IB: District will conduct conference with user and A-E (or design branch) to discuss basic criteria. SecDef approves spec. projs.	+With likelihood of project's success, OCE may approve final design in lieu of concept design. +A-E audit may be waived if one has been conducted within the past year. +Changes to standard design requires OCE approval. +DAEN-MCE-A for criteria changes or use of brand names. +Late starts, fallout from previous years and complex designs generally require a waiver to the 31 October deadline.
31 Oct FY-1	For Congressional hearings	+Rise in const. costs taken into consideration. +Last chance for revisions before going to Congress. +Is based on the completed concept drawings - See Budget Estimate above (alternate).	+Construction cost limit considered inappropriate for a particular project may be waived with substantiating data submitted with a request for waiver.
	Review Committee of Deputy Chief of Staff for Logistics (CCRC) Sec'y Army to Sec'y Defense w/surviving 1391's. (Justification Books)		

MCA PROJECT PROCEDURE	FORM	PREPARATION BY	SUBMITTED BY	SUBMITTED TO	VIA
Siting Instructions & Design Criteria		**Installation**	**Installation**	**District**	
Annotated General Site Plan	In accord w/ AR 210-10	District - or by installation	Major Command	Chief of Engl (DAEN-MCE-P)	
Detail Site Plan	In accord w/ Section 15 AR 210-20 TM-5803-1	District	Major Command	Chief of Eng. (DAEN-MCE-P)	Installation
Approval to Initiate Concept Design	Machine list	DCSLOG (CRRC)	Chief Engr.	District	Division
Projects approved for Final Design	**Final design Directive**	OCE	OCE	District	Division
Final Design	Construction Documents (In accord w/AR 415-20)	A-E or District in-house staff	A-E ..... District...	District if A-E design Approval Division if District design	Optional User
Military Construction Authorization Act	**Public Law**	Congress	Congress	Secretary of Defense	
Military Construction Appropriation Act	Public Law	Congress	Congress	Department of	Bureau of Budget Ofc Secretary of Defense
Construction Award	Construction Execution Program Schedule. ENG 3635	OCE	OCE	BOB for approval then to Dept. of Army, then to Districts	

TARGET DATES	ACTION TAKEN BY	REMARKS	POSSIBLE WAIVERS OR ALTERNATES FOR IBS
1 Dec FY-2	District Engr.	+Provides functional requirements for a project	
15 Mar FY-2	OCE approval	+Accompanies Short-Range Program +Projects in current program must appear on approved General Site Plan	+Change in mission would permit non-sited projects
15 May FY-2	OCE	+Essentially an enlargement of General Site Plan +Accompanies Short Range Construction Program	
May FY-2	District	+Indicates status of	May be waived and final design initiated in lieu of concept design
Jan-Mar	District		
30 June FY-1	District hired labor or District AE	+Normally must be in accordance with previously approved concept design.	+Occurs after contract is awarded with IBS. Review by using activity would be of rough schematics and performance criteria to occur at concept stage.
May-July FY	Appropriation committees after authorization		
October-December FY		+May be deferrals in some projects which are placed in succeeding year's program. +Cannot award contract until Act has passed.	
30 June FY (frequently later)	District	+Subdivision and allocation of funds by Bu of Bud. and Dept. of Defense. +Directive by OCE	+See "Strategies" this Guide

SECTION TWO

STANDARD CONTRACT CLAUSES

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2:220 SCOPE

The list of ASPR Clauses are divided into required and optional clauses. Only the most pertinent clauses to industrialized building projects are listed under "Clauses to be Used when Applicable" and "Additional Clauses" (corresponding to the ASPR categories).

2:221 REQUIRED CLAUSES

	ASPR No.
Accident Prevention (June 1967)	7-602.42
Additional Bond Security (July 1949)	7-602.17
Additional Definitions (Jan. 1965)	7-602.41
Assignment of Claims (June 1964)	7-602.8
Authorization and Consent (Mar. 1964)	7-602.31
Buy American Act (Oct. 1966)	7-602.20
Changes (Feb. 1968)	7-602.3
Cleaning Up (Jan. 1965)	7-602.40
Commencement, Prosecution and Completion of Work (Jan. 1965)	7-602.44
Composition of Contractor (Jan. 1965)	7-602.32
Conditions Affecting the Work (June 1964)	7-602.14
Contract Drawings, Maps and Specifications (Jan. 1965)	7-602.45
Contractor Inspection System (Nov. 1964)	7-602.10
Convict Labor (Mar. 1949)	7-602.21
Covenant Against Contingent Fees (Jan. 1958)	7-602.18
Definitions (June 1964)	7-602.1
Differing Site Conditions (Feb. 1968	7-602.4
Disputes (June 1964)	7-602.6
Equal Opportunity (Apr. 1971)	7-602.22
Federal, State and Local Taxes (Nov. 1971 and Oct. 1966)	7-602.27
Government Inspectors (Jan. 1965)	7-602.43
Gratuities (Mar. 1952)	7-602.25
Inspection and Acceptance (June 1964)	7-602.11
Labor Standards Provisions Apprentices (Apr. 1965)	7-602.33
Listing of Employment Openings for Veterans (n.d.)	7-602.49
Material and Workmanship (June 1964)	7-602.9
Minority Business Enterprises (Nov. 1971)	7-602.48
Modification Proposals - Price Breakdown (Apr. 1968)	7-602.36
Non-Domestic Construction Materials (Oct. 1966)	7-602.24
Notice and Assistance Regarding Patent and Copyright Infringement (Jan. 1965)	7-602.30
Officials Not to Benefit (June 1964)	7-602.19
Operations and Storage Areas (Jan. 1965)	7-602.35
Other Contracts (June 1964)	7-602.15
Patent Indemnity (June 1964)	7-602.16

Payments to Contractor (June 1964)	7-602.7
Permits and Responsibilities (June 1964)	7-602.13
Pricing of Adjustments (July 1970)	7-602.38
Protection of Existing Vegetation, Structures, Utilities and Improvements (Jan. 1965)	7-602.34
Renegotiation (Oct. 1959 and Jan. 1961)	7-602.28
Rights in Shop Drawings (Apr. 1966)	7-602.47
Site Investigation (Jan. 1965)	7-602.33
Small Business Subcontracting Program (Maintenance, Repair and Construction) (June 1967)	7-602.26
uSpecifications and Drawings (June 1964)	7-602.2
Subcontractors (Oct. 1966)	7-602.37
Superintendency by Contractor (June 1964)	7-602.12
Suspension of Work (Feb. 1968)	7-602.46
Termination for Convenience of the Government (Jan. 1965 and July 1970)	7-602.29
Termination for Default - Damages for Delay - Time Extensions (Aug. 1969)	7-602.5
Use and Possession Prior to Completion (Jan. 1965)	7-602.39

2:222 CLAUSES TO BE USED WHEN APPLICABLE

	ASPR No.
Advance Payments (Apr. 1969)	7-603.14
Airfield Safety Precautions (Apr. 1968)	7-603.49
Architectural Designs and Data - Government Rights (Apr. 1966)	7-603.42
Audit by Department of Defense (Apr. 1971)	7-603.20
Availability and Use of Utility Services (Apr. 1967)	7-603.30
Competition in Subcontracting (Apr. 1962)	7-603.18
Contract Prices - Bidding Schedule (Apr. 1968)	7-603.5
Cost Accounting Standards	7-603.58
Disputes Concerning Labor Standards (Jan. 1965)	7-603.26
Equal Opportunity Pre-Award Clearance of Subcontracts (Oct. 1971)	7-603.46
Examination of Records by Comptroller General (Mar. 1971)	7-603.7
Exclusion of Periods in Computing Completion Schedules (Jan. 1965)	7-603.38
Filing of Patent Applications (Oct. 1966)	7-603.3
Identification of Expenditures in the United States (Oct. 1966)	7-603.43
Interest (May 1968)	7-603.17
Interest on Contractor's Claims	7-603.51
Management Systems Requirements (Nov. 1971)	7-603.31
Misplaced Material (Jan. 1965)	7-603.32
Notice of Imports - Possible Duty-Free Entry (Feb. 1971)	7-603.19
Notice of Government of Labor Disputes (Sept. 1958)	7-603.1
Patent Rights (License) (Dec. 1969)	7-603.16
Patent Rights (Title) (Dec. 1969)	7-603.16
Payment for Mobilization and Preparatory Work, Payment Item No. (Jan. 1965)	7-603.37

Performance of Work by Contractor (Jan. 1965)	7-603.15
Physical Data (Jan. 1965)	7-603.25
Price Reduction for Defective Cost or Pricing Data (Jan. 1970)	7-603.11
Progress Charts and Requirements for Overtime Work (Jan. 1965)	7-603.48
Quantity Surveys (Apr. 1968)	7-603.50
Refund of Royalties (Feb. 1968)	7-603.4
Salvage Materials and Equipment (Jan. 1965)	7-603.29
Shop Drawings (Jan. 1965)	7-603.24
Subcontractor Cost or Pricing Data (Jan. 1970)	7-603.21
Subcontracts (Apr. 1967)	7-603.9
Superintendence of Subcontractors (Jan. 1965)	7-603.35
Time Extensions for Delay (Jan. 1965)	7-603.36
Variations in Estimated Quantities (Apr. 1968)	7-603.27

2:223 ADDITIONAL CLAUSES

	ASPR No.
Alterations in Contract (Jan. 1961)	7-604.1
Contractor-Prepared Network Analysis System (Apr. 1968)	7-604.7
Government-Prepared Network Analysis System (Apr. 1968)	7-604.8
Layout of Work (Jan. 1965)	7-604.3
Warranty of Construction	7-604.4

chapter three

PERFORMANCE SPECIFICATIONS

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SECTION ONE

STANDARDS AND SOURCES FOR PERFORMANCE CRITERIA

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2:310 GENERAL DESCRIPTION

Covered here are recommended levels which should be used in performance specifications for the different building types (housing, classroom/administration facilities, storage facilities). These performance levels are related to criteria contained in DOD 4270.1-M (October 1972), and examples are taken from the best precedents available, particularly from recent Army, Air Force, GSA and URBS systems documents. Some of these clauses may be used almost verbatim in the specifications, while some will need modification and amplifications.

See Section 2:320

Objective: To provide Contracting Officers both with means to identify required levels of performance and with means to evaluate available systems, subsystems or components against DOD performance standards.

Methods and Procedures: To achieve these twin objectives, we set these tasks or goals:

- to **identify principal subsystem** required for the construction of the listed building types, utilizing currently available industrialized building products or techniques;
- to **subdivide these subsystems** into elements and characteristics which require evaluation *to determine acceptability;*
- to **identify elements and characteristics governed by the DOD Construction Criteria Manual,** 4270.-1M, October 1, 1972 Edition (henceforth termed "DOD"), and to identify its requirements;
- to **develop and recommend performance standards** for each of the elements, based on one or more of the following:
  - DOD requirements;
  - requirements of nationally-recognized code authorities, trade associations and professional societies;
  - results of similar private and public studies, conducted for similar purposes for similar building types;
  - minimum standards for Federally-financed housing;
  - current technological and production capability of private industry; and
  - professional judgment by CERL;
- to **apply performance standards** to each of the three building types (housing, classroom/administration and storage facilities).

Assumptions: In the selection of recommended performance standards, note that:

- design and planning criteria (size, functional relationships, esthetics, modularity) are intentionally excluded, although such criteria *are necessary for the optimum IBS utilization;*
- military projects are assumed not to be governed by local and state codes, building or zoning authorities or insurance rating bureaus;
- buildings are assumed not to exceed three stories and also are not influenced by adjacency to hazardous or other special occupancies;
- performance standards have been selected as the best or most appropriate means for controlling the design of the proposals; and
- industrialized building systems, subsystems and components are assumed not to be necessarily procured or constructed through *currently authorized methods.*

Application to Building Types: A checkmark in one of the right-hand columns signifies that the "Recommended Standard" is pertinent to that building type; no mark means "not normally applicable" or "not recommended"; abbreviations in column headings are defined as follows:

- "ADM/CLR": Administrative/Classroom Facilities
- "Housing": includes BOQ's (Bachelor Officer Quarters) and EMB's (Enlisted Men's Barracks)
- "Storage": Warehousing and other storage facilities.

Explanation of Format: At the top of each table, a *major* heading identifies the principal "subsystem." Each heading is followed by the last digit of the sub-section number. The main body is divided into three columns:

- "Elements/Characteristics" includes numbered sub-headings and unnumbered subheadings to further subdivide the subject analyzed;
- "DOD Criteria" listings related to those under the "Elements/Characteristics" column. In many cases DOD Criteria are necessarily specified in descriptive terms as expressed in the DOD Manual. The absence of entries signifies no applicable DOD criteria are available;
- "Recommended Standards" include performance standards related to listings under "Elements/Characteristics" column. Insofar as is predictable, these standards are in measurable terms.

Reference to test methods, recognized standards and similar criteria are indicated in parenthesis in the Tables.

Abbreviations: Organizations are identified in the tables as follows:

ACI	American Concrete Institute
AGA	American Gas Association
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators International
CS	Commercial Standard
CSI	Construction Specifications Institute
FS	Federal Specification
FTMS	Federal Test Method Standard
HUD	Department of Housing and Urban Development
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineers Society
ISO	International Standards Organization
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NPC	National Plumbing Code
SJI	Steel Joist Institute
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.

Addresses of the Organizations are given in Section 2:440.

Abbreviations: Titles of Performance Specifications: The issuing agencies for the specifications listed in the Tables are identified as follows:

AF(Hsg) RFTP (Housing) United States Air Force Industrialized Construction Program, DACA 63-72-R-0006 (4 April 1972), Fort Worth District Corps of Engineers.

FK FRP (250 Man BOQ) Fort Knox, Kentucky, DACA 31-73-R-0008 (27 November 1972), Baltimore District Corps of Engineers.

GSA Performance Specifications for Office Buildings, Public Buildings Service, General Services Administration (Jan. 1971).

URBS Contract Documents and Performance Specifications, University Residential Building System, Publication No. 1, University of California Physical Planning and Construction, 641 University Hall, Berkeley, California 94720.

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
1.1 Static Loads **Dead Loads**	Where the structural system cannot be analyzed on a rational basis, acceptability of the load carrying capacity shall be determined by suitable load testing (DOD 6-1.3)				
	The structural systems and materials to be selected—shall be capable of carrying the required loads—(DOD 6-1)	*All structural elements shall be designed to safely suport all dead loads, permanent or temporary, including self-weight, roofing, insulation, ceilings, floor covering and mechanical equipment.*	✓	✓	✓
	The load assumptions for the design of buildings and other structures including chimneys, tanks, and related structures, shall conform to the guidance provided in (a) the Joint Army-Air Force Manual TM 5-809-1, AFM 88-3, Chapter 1, "Load Assumption for Buildings", or corresponding guidance contained in NAVFAC Design Manuals; and (b) Joint Services Manual TM 5-809-10, NAVFAC P-355, AFM 88-3, Chapter 13, "Seismic Design for Buildings." (DOD 6-3.1)				
	Wind loads, snow loads and frost penetration shall be carefully established for each structure in accordance with local climatic conditions. (DOD 6-3.2)				
	Design loads for warehouses shall conform to the guidance provided in the joint Army-Air Force Manual TM 5-809-1, AFM 88-3 Chapter 1, "Load Assumptions for Buildings" and guidance in NAVFAC Design Manual (DOD 3-9.4 A(1))				✓
Live Loads-Roof		*See FK 5A.2 line 47*	✓	✓	✓
Live Loads-Floor		*See model codes such as Building Officials and Code Administrators International (BOCA), Uniform Building Code (UBC), American National Standards Institute (ANSI).*	✓	✓	✓
Partition Allowances		*See FK 5A.3 line 1*	✓	✓	✓
Live Loads-Concentrated: floors		*For ADM/CLR see GSA pp. G10 and G11*	✓		

Perf. Specs

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
1.2 Dynamic Loads	See 3.2 herein, and DOD 6-3.5	*Same as DOD G-3.5*	✓	✓	✓
Hurricane-Typhoon Vibration & Seismic	See 1.1 herein, and DOD 6-3.1	*See also UBC* *Same as DOD 6-3.1* *For vibration see also FK 5A.5 line 1*	✓	✓	✓
Impact		*See Model Codes*	✓	✓	✓
1.2a General-All Loads	Design methods and stress allowances or load factors for the various structural materials shall be in accordance with the current editions of the codes and specifications listed in Table 6-1 (Aluminum Assn; ACI; ANSI; SCPI; NCMA; AISC; SJI; AISI; NFPA) except as modified or expanded by published design criteria of the Military Departments. (DOD 6-3.3)	*Same as DOD*	✓	✓	✓
1.3 Deflection		*FK 5A.3 line 10*	✓	✓	✓
Vertical:					
with ceiling					✓
without ceiling		*All floor and roof members shall be cambered to eliminate deflection arising from dead load to the extent required to assure correct interface with other Subsystems herein including calculated time-based deflection due to specific material properties.*	✓	✓	✓
camber					
Horizontal:					
total buildings		*FK 5A.4 line 1*	✓	✓	✓
walls		*FK 5A.4 line 24*	✓	✓	✓

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
1.4 Types of Construction					
Fire Resistive Construction	The following will be of fire resistive construction: a. Hospitals, etc.				
	b. Barracks, BOQ's and administrative facilities exceeding three stories in height. Fire areas per floor for barracks and BOQ's in this type of construction are not limited.		✔	✔	
	c. Dependent school buildings more than three stories in height.		✔		
	d. Buildings, or areas within buildings, such as vaults used for storage of documents, which are required to prevent outside fires from destroying or damaging the contents.				✔
	e. Buildings or areas within buildings used for storage of hazardous chemicals or materials in order that a fire within the building or within the space of the building will be prevented from spreading to the adjoining building(s) or areas. (DOD 12-5.1)				✔
Protected Noncombustible Construction	One-story hospitals and all other buildings exceeding three stories in height not included in DOD 12-5.1 shall be protected noncombustible construction. (DOD 12-5.1)				
Noncombustible Construction	Buildings, except as stated in Sections 12-5.1, 12-5.2, or 12-5.4, shall be of noncombustible construction. Dependent school buildings two and three stories in height shall be noncombustible construction. Bents of glued laminated wood may be used in this type of construction. Fire areas for barracks and BOQ's in this type of construction are limited to 20,000 square feet per floor. (DOD 12-5.3)		✔	✔	

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Ordinary and Wood Frame Construction	Small and light hazard buildings, not specifically covered herein, may be of ordinary or wood frame construction where warranted by local conditions or where economies may be effected—(they) shall not exceed one story and each classroom shall have a direct exit to the outside. Other buildings—shall not exceed two stories in height if unsprinklered or three stories if completely protected by automatic sprinklers. Fire areas for barracks and BOQ's in this type of construction are limited to 5000 square feet per floor. (DOD 12-5.4)		✓	✓	✓
1.4a Fire Protection					
Fire Resistive					
Structural framing	2 hr				
Load-bearing walls	*2 hr*				
Floor-ceiling	2 hr				
Prot. Noncombustible					
Structural Framing	1 hr				
Load-bearing walls	1 hr				
Floor-ceiling	1 hr				
Non-load-bearing walls	Non-combustible for fire-resistant construction	*See GSA pp. G30-32 and NBC*	✓	✓	✓
Enclosures					
Shafts (stairs, elevators, etc.)					
Fire resistive	2 hr rating (min)				
All other types	1 hr				
Heater/Boiler rooms					
Walls & ceilings	1 hr all types of construction with outside entrance only.				
Storage Areas **If containing combustible storage**	1 hr rating, all types of construction	*As DOD*			✓
1.5 Acoustics					
Structure-borne Noise		*FK 5A.8 line 1; GSA p. G9*	✓	✓	

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
1.6 Compatibility **General**		*All structural elements will be designed to support and interface with, when required, other Subsystems herein. See also URBS Vol. I 6 VI IE*	✓	✓	✓
Dimensional Tolerance **Horizontal:** **members** **location** **total module**		*See URBS Vol. I 6 VI IFS where applicable.*	✓	✓	✓
Dimensional Tolerance **Vertical:** **members** **location** **total story height**		*See URBS Vol I 6 VI IFS where applicable.*	✓	✓	✓
1.7 Material Properties: **Characteristics**	The structural systems and materials to be selected shall be suitable for permanent type military facilities, shall be capable of carrying the required loads and shall be compatible with fire protection requirements and architectural and functional concepts. Materials may be any of those listed in Table 6-1 or any combination thereof, selected for economy, general availability, desirability, resistance to fire, and low maintenance costs over the design life of the facility (DOD 6-1) In choosing structural materials for a specific project, consideration shall be given to (a) the site environment, including climate, subsurface conditions, accessibility, wind velocity, and seismic ratings; (b) skill and experience of prospective contractors; (c) the design life of the facility and maintenance costs over this period; (d) experience of the design and inspection personnel; (e) availability of labor and materials; and (f) the feasibility of preassembling or precasting major structural elements (DOD 6-2)	*Same as DOD*	✓	✓	✓

Subsystem: 1.0 STRUCTURE

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Volume Change		*See FK 5A.5 line 26. Also AF (Hsg) B2-2*	✔	✔	✔
Deterioration Resistance: **corrosion** **decay** **spalling** **leaching** **delamination**	Materials may be any of those listed in Table 6-1 or any combination thereof, selected for economy—desirability,—and low maintenance costs over the design life of the facility (DOD 6-1)	*Design Structure Subsystem to (a) eliminate continuous voids between sources of moisture-laden air and structural surfaces which can be at a temperature below dew point, (b) provide vapor barriers, ventilation or other means to prevent passage of water vapor from warm, moisture-laden areas to concealed structural surfaces subject to condensation, and (c) resist reduction in strength, during the anticipated life of the structure, due to exposure to climatic conditions normal to the site. See also FK P5A.8 line 11. See also GSA p G26-28.*	✔	✔	✔
1.8 Spatial Characteristics					
Bay Size	25 x 40 feet recommended most economical for steel and concrete (DOD 3-9.4A.)	*30 x 50 feet for optimum cost for steel; 30 x 30 feet for optimum cost for concrete or timber.*			✔
Story Heights: **administration** **barracks and dormitories** **BOQ's**	Shall be designed to practical minimums taking into account optimum cost trade-offs with structure and mechanical systems. (DOD 3-3.2) as above	*As required to produce clear ceiling heights as set forth in the functional program for the facility.*	✔	✔	
	Where specific DOD criteria are not available the floor-to-floor heights shall be at a minimum consistent with current economical practice. Spaces requiring special ceiling heights should be located on the least number of floors consistent with proper functional design. For single-story design, spaces requiring special ceiling heights should be grouped together to the extent feasible under a single raised roof area (DOD 5-1.5B)	*See also URBS 1 VI IE 4*	✔	✔	✔
Clear Height	12 to 19.5 feet clear (DOD 3-9.4 C(1) & (2))	*Same as DOD or as set forth in the functional program for the facility.*			✔
Penetration		*Design to permit penetration, horizontal and vertical, by electromechanical services required by other Subsystems herein.*	✔	✔	✔

Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
2.1 General	Design methods and stress allowances or load factors for the various structural materials shall be in accordance with the current editions of the codes & specifications listed in Table 6-1 (DOD 4270 1-M Oct 1 1972) except as these codes and specifications may be modified or expanded by published design criteria of the Military Departments.	*See AF B 3-1*	✓	✓	✓
2.2 Strength					
Lateral loads	Wind loads, snow loads, and frost penetration shall be carefully established for each structure in accordance with local climatic conditions. (DOD 6-3.2)	*Same as DOD FK 5B.1 line 23, 37 & 41*	✓	✓	✓
Impact		*Per ASTM E72-68, Sections 12 and 13; test conducted on full height panels; instantaneous deflection shall not exceed 1 inch nor permanent set of 1/16 inch after 5 drops at various heights. Surface shall show no cracking or chipping when tested per MIL-T-1717a, paragraph 4.4.4.6 or subsequent revisions. Also: FK 5B.1 line 26 and AF(H) B 3.5*	✓	✓	✓
2.3 Fire Safety	See DOD 12-5 & 12-6				
Structural Framing					
Load-Bearing Walls and Floor/Clg. Constr.					
prot. non-combustible	1 hr (DOD 12-6.1)	*As DOD*	✓	✓	✓
unprot. non-comb.	2 hr (DOD 12-6.1)	*Also see FK 5B.1 line 49*	✓	✓	✓
Non-load-bearing Walls	Shall be non-combustible for fire resistive construction (DOD 12-6.2)	*As DOD Also see FK 5B.1 line 49*	✓	✓	✓
Insulation (Thermal & Acoustical)					
fire rating		*Non-combustible. See also AF B3-7*	✓	✓	✓
flame spread	25 max. (DOD 12-6.6)	*25 max. See also AF B3-7*	✓	✓	✓
smoke generation	50 max. (DOD 12-6.6) (ASTM t-84 Test) Also see DOD 12-6.6 for exceptions	*50 max. See also AF B3-7 Ratings for walls and insulation shall meet Fire Resistive Classification per UL.*	✓	✓	✓

Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Flame Spread		*FK 5B.2 line 4*	✓	✓	✓
Smoke		*See FK 5B.2 line 13*	✓	✓	✓
Potential Heat		*The limit of combustibility for any square foot of exterior wall section classed non-combustible, excluding wall finishes, shall not exceed 8000 BTU when tested in accord with ASTM Proceedings 61(15) or subsequent revisions.*	✓	✓	✓
2.4 Finish Properties		*For interior finish properties see Subsystem: 5.0 Interior Partitions herein.*	✓	✓	✓
Interior color	Federal Std. No. 595 (DOD 5-2)				
Exterior		*Federal Std. No. 595 No restriction except texture shall not adversely affect compliance with other Properties Standards required herein. See also AF(Hsg) B3-2*			
color	Federal Std. No. 595 (DOD 5-2)		✓	✓	✓
texture			✓	✓	✓
Weathering		*Exposure to weathering elements shall not impair basic wall resistance to loads or water and air infiltration, nor deteriorate the wall to such an extent as to prohibit meeting Properties Standards as required herein. See also FK 5B.4 line 8.*	✓	✓	✓
Moisture		*14 day exposure per Method 6201 of FTMS 141a shall result in no change in adhesion or resistance to abrasion or scratch of surface when tested as follows:* *Adhesion: Method 6303.1 FTMS 141a* *Abrasion: Method 4421 FTMS 141a* *Scratch: Method 7711 FTMS 501a* *or subsequent revisions* *Also see AF(Hsg) B3-15.*	✓	✓	✓
Water and Light		*No surface change after 2000 hr. exposure per Method 6152 of FTMS 141a or subsequent revisions.*	✓	✓	✓

Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Corrosion		*No corrosion after 7 days exposure per Method 6061 of FTMS 141a (salt spray or fog test) or subsequent revisions.*	✓	✓	✓
Chemical Resistance		*Resist staining or damage from soluble and insoluble salts, alkali attack, corrosion, oxidation or other forms of attack from atmospheric conditions and normal care of surface.*	✓	✓	✓
Biological Resistance		*Resist damage from insects, rodents, vermin, mildew, fungi, algae or other forms of attack from organisms.*	✓	✓	✓
2.5 Wall Properties		*For solid walls, with or without glazing, Sound Transmission Class (STC) shall be equal to or greater than 42;*	✓	✓	✓
		for a 10' x 20' solid wall section with a door, STC shall be equal to or greater than 37. See also AF. Hsg. B3-7 Para 38	✓	✓	
Thermal General	Inside design temperature shall be 70°F for living and administrative areas (inactive employment), 55°F-65°F for working areas (active employment), and 40°F for storage areas for prevention of freezing (DOD 9-2.1)	As DOD	✓	✓	✓
	"U"—factor for the major elements shall not be greater, numerically, than those set forth in Table 9-2, below (DOD 9-2.2B)	As DOD	✓	✓	✓

(a) *All facilities heated to min. of +70°F*

	−40°F to −10°	−9°F to +10°	+11°F to +50°
	*"U" Factor**		
Walls	.07	.10	.15
Floors over Vent & Crawl Space	.05	.07	.10
Ceilings and/or roofs	.05	.05	.05

(b) *All shop areas for installation, maintenance and similar facilities*

	−40°F to −10°	−9°F to +10°	+11°F to +50°
Walls	.10	.15	.20
Ceilings or roof	.07	.10	.10

* *Floors to be in accordance with ASHRAE Guide for "Slabs on Grade" and Section 9-2.2.C which states:*

Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
	Perimeter Insulation When heated spaces are adjacent to exterior walls in slab-on-grade construction, perimeter insulation shall be installed on the interior of foundation walls as follows: 1-inch thick when annual heating degree days aggregate from 3500-4500, and 2 inches thick when the annual heating degree days are 4500 and over. Installation of the insulation shall be in accordance with the ASHRAE Guide. (DOD 9-2.2.C)	*If, for reasons of minimum natural light or essential architectural treatment, the heat loss in any one particular wall is above the limits set, it shall be compensated for in the heating system or window accessories.*			
		Summer Heat Gain-Walls: *under summer design dry bulb conditions and 75°F indoor temperature heat gain through walls shall not exceed 4 BTU/hr/sq. ft. of wall.*	✓	✓	✓
		Summer Heat Gain-Windows: *the solar heat gain through windows shall not exceed a maximum average of 26 BTU/hr/sq. ft. of exposed wall and glazing in any orientation; glazed areas shall be limited and/or shielded to maintain this value.*	✓	✓	
Vapor Penetration		*Provide a vapor barrier having a permeance of less than or equal to 1 perm on the winter warm side of the wall when the wall "U" factor is less than or equal to .25 or if the permeance of the outside (cold) surface is less than 5 perms; tested in accord with ASTM Dry Cup Test Procedure "A," E96-66 or subsequent revisions.*	✓	✓	✓
Moisture Penetration		***Exclude all water at doors, windows and walls; in order to neutralize pressure differential which draws moisture through wall, provide an air chamber sealed on the building side and ventilated to the outside air between the insulation and the outside wall material.*** ***Walls tested per NAAMM Std. TM-1-68T(13) or ASTM E331-68.*** ***Windows tested per NAAMM Std. SW-1-77 (18) or ASTM E331-68 or subsequent revisions.***	✓	✓	✓

Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Air Infiltration		*Maximum air infiltration for fixed wall shall not exceed 0.06 CFM/sq. ft. of exposed wall and for operable windows shall not exceed 0.05 CFM/lin. ft. of operable sash perimeter.* *Walls tested per NAAMM Std. TM-1-68T(13) or ASTM E283* *Windows tested per NAAMM Std. SW-1-71(18) or ASTM E283 or subsequent revisions.*	✓	✓	✓
Condensation	Where crawl spaces are enclosed, they shall be adequately and properly ventilated or otherwise treated to effectively control passage of moisture from the ground to building elements. Where facilities are constructed in cold regions which require insulation added to walls, floors over crawl spaces, and roof or ceilings, effective steps shall be taken to prevent excessive condensation. (DOD 8-7.6) *Barracks and BOQ's* Mechanical ventilation may be provided in barracks, dormitories and BOQ's when needed to control condensation and odor in climate areas where the winter design temperature is -20°F or less. (DOD 8-7.6.A)	*Thermal breaks shall be provided in highly conductive materials used in the construction of wall panels, doors, and windows where cold spots would contribute to the formation of condensation. With single glazing provide condensation gutters.*	✓	✓	✓
Volume Changes		*Thermal movement due to ambient temperature range of 120°F shall be compensated for in design and fabrication of joints to permit expansion and contraction of components without impairment of performance against air and water leakage or objectionable buckling.*	✓	✓	✓
2.5a Storm Sash and Insulating Glass.	Provision of storm sash and doors or insulating glass in barracks, BOQ's, and family housing shall normally be considered where winter design temperature is 10°F dry bulb or less. Exceptions may be granted by H.Q. level of each Military Department. (See DOD 5-4 generally)			✓	

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Subsystem: 2.0 EXTERIOR WALLS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
2.6 Natural Light and Ventilation General	In administrative facilities, barracks, BOQ's, dormitories, classrooms and patient bedrooms in hospitals, located where winter design temperature is less than 0°F or where summer design temperature exceeds 95°F, the glass area shall not exceed 15% of the floor area. For other facilities, fenestration shall be planned to take optimum advantage of natural light and ventilation with full consideration of its impact on the heating and air conditioning load. In regions where other provisions are not made for cooling and ventilation, natural ventilation shall be used to minimum degree consistent with local engineering practice and consideration of heating costs. (DOD 5-5).	*Same as DOD*	✓	✓	
Windows in Exterior Walls	All barracks, BOQ's, family quarters and bedrooms in hospitals shall be provided with opening windows in exterior walls. Sash, when fully opened, will allow for emergency egress. Fixed fenestration may be used in fully air-conditioned building areas, provided appropriate means of emergency egress is provided (DOD 5-5.1)			✓	
2.7 Compatibility		*Exterior wall subsystem shall be designed to interface with other subsystems herein.*	✓	✓	✓
General penetration		*See also URBS Vol I 6 VI IE where applicable.* *Subsystem shall be capable of accommodating passage of electromechanical branch services to other subsystems herein, vertically and horizontally, either within the wall thickness or within cavities formed of similar components.*			

Subsystem: 3.0 ROOF/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
3.1 General	Refer to Subsystem: 1.0 Structure herein and to to DOD 6-1; 6-2; and 6-3.	*Refer to Subsystem: 4.0 Floor/Ceiling for ceiling Standards also applicable to this subsystem with regard to strength, finish properties, acoustics and integrated lighting/ceiling; otherwise, standards for roof/ceiling are stated herein.*	✓	✓	✓
Thin Shell and Folded Plate Construction	The feasibility of using concrete thin shells or folded plates shall be investigated for the design of those facilities where large unobstructed spaces are desired. If generally feasible, such design shall be developed as one of the alternatives in the required economic analysis (DOD 6-3.4)				
3.2 Strength					
Live Loads:		*Same as Subsystem: 1.0 Structure herein.*	✓	✓	✓
roof	See Subsystem 1.0: Structure (DOD 6-3.1)				
wind	See Subsystem 1.0: Structure (DOD 6-3.2)				
Dynamic Loads:					
hurricane-typhoon	Structural integrity and continuity must be provided from foundation to roof irrespective of materials selected. All components must be tied together. In design of drag-sensitive structures, effect of maximum wind forces and pulsating forces must be considered. Design criteria for structural framing, openings and flashings to be in conformity with Joint Army-AF Manual TM 5-809-11, AFM 88-3, Chapter 14, "Design Criteria—Tyhpoons and Hurricanes," or corresponding guidance in NAVFAC Design Manuals (DOD G-3.5)	*Same as subsystem: 1.0 Structure herein*	✓	✓	✓
Vibration—Seismic	See Subsystem: 1.1 herein and DOD 6-3.1				
Penetration Resistance		*Roof shall support 250 pounds on 4 sq. in. without puncture or failure of membrane or insulation.*	✓	✓	✓
		Roof shall resist light foot traffic without adverse effect; and resist impact of 1½-inch hail at 112 ft./sec. with no water entry when tested.	✓	✓	✓

Subsystem: 3.0 ROOF/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
3.3 Fire, General	Except as modified herein, or by specific criteria issued by the military departments, fire protection criteria shall conform to standards contained in current National Fire Code Vols. 1-x published by NFPA (DOD 12-1)				
Fire Safety Rating	Structural Framing, Load-Bearing Walls, and Floor/Ceiling Constr: These elements shall have a minimum of two-hour rating for fire resistive construction and one-hour rating for protected noncombustible construction (DOD 12-6.1)	*Minimum 3/4 hr when tested in accord with ASTM E119-67 or subsequent revisions.*	✓	✓	✓
Flame Spread:	Non Load-Bearing Walls: shall be noncombustible for fire resistive construction (DOD 12-6.2)				
roof		*Flame spread rating of roofing surface shall be Class C or better when tested in accord with ASTM E108-58 or subsequent revisions.*	✓	✓	✓
ceiling	Interior finish shall conform to NFPA Standard No. 101 except: (a) Interior finish for "Exits" shall be Class A only. (b) Class C, D & E interior finish materials are not permitted. (DOD 12-6.5)	*See FK 5D.1 line 51*	✓	✓	✓
Smoke Generation	For interior finish, "Smoke Developed" classification by ASTM E-86 Test shall be: (1) Not higher than 50 for Class A interior finish materials (2) Not higher than 100 for Class B interior finish materials	*See FK 5D.1 line 55*	✓	✓	✓
Fire Paths	(DOD 12-6.5c)	*See AF(Hsg) B3-7*			
Potential Heat		*The limit of combustibility for any square foot of roof/ceiling assembly (applied only to the structural part of the assembly and its fire protection) shall be 5,000 BTU when tested in accord with ASTM Proceeding 61 (15) or subsequent revisions.*	✓	✓	✓
Roof Covering	Class A, B or C listed by UL, Factory Mutual Engineering Division or other recognized testing laboratory.	*See AF (Hsg) B 3-14 Para 78*	✓	✓	✓

Subsystem: 3.0 ROOF/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Insulation: (Thermal & Acoustical)		*Same as DOD with subsequent revisions of E-84 test. See also FK 5C.2 line 13*	✓	✓	✓
classification	non-combustible				
flame spread	rating not higher than 25				
smoke developed	rating not higher than 50 by ASTM tests Except: (a) Compliance with smoke developed limitation not required where isolated from interior of building by masonry walls (cavity walls) or concrete floors (DOD 12-6.6a) (b) Compliance with flame spread and smoke developed limitation not required for insulation installed above non-combustible roof decks where decks and insulation fire tested and approved by UL, or Factory Mutual Lab for such use. (DOD 12-6.6b)				
	For dehumidified warehouses with temperature and humidity control: Exterior and interior walls separating areas with different temperature & humidity—permeance factor & "U" of 0.10; Roofs to have "U" factor of 0.05 and insulated ceiling under the structural framing (DOD 3-9.2 b(1))				✓
3.4 Assembly Properties— Acoustics: sound isolation		*STC (Sound Transmission Class) shall be equal to or greater than AIA Chapter 13 (17) when tested in accord with ASTM E90-66 and subsequent revisions. See also FK P 5C.2 line 21 and AF(Hsg) B3-7 para 38.*	✓	✓	
Impact		*IIC (Impact Insulation Class) values shall be equal to or better than FHA Criteria of Impact Noise Curve per AIA Chapter 13 (17), with INR (Impact Noise Reduction) of minus 5 for office and classroom areas, when tested in accord with ISO $140-1960 (21). or subsequent revisions.*	✓	✓	

Subsystem: 3.0 ROOF/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Heat Transmission		*Calculated per ASHRAE methods:*	✓	✓	
personnel-type facility heated to min. 70°F.		*"U" = 0.07 max.*			
warehouse	Insulation may be applied either on the roofs, below the roof, or in combination as long as the overall "U" factor is achieved. Roofs shall provide the following max. "U" factors: U = .12 at -40°F to -10°F U = .18 at -9°F to +10°F U = .25 at +11 to +35°F (DOD 3-9.4K)	*Same as DOD*			✓
Water Resistance: general		*Susceptible roof construction (e.g. gypsum) shall not be permanently damaged or rendered unsafe in the event of wetting from humidity or other cause and shall be capable of drying to the indoor air.*	✓	✓	✓
leakage		*Membrane and flashings shall not allow water penetration for 20 years. See National Roofing Contractors Association Standards.*			
moisture		*Provide vapor barrier with permeance not greater than 1/2 perm near the winter warm side of construction and provide ventilation of insulation to the outside air, to protect against moisture accumulation in insulation or at interface of membrane and deck.*	✓	✓	✓
condensation		*Provide thermal break in materials with high thermal conductance (e.g. metals) when used in construction where cold spots contribute to condensation. With skylight detailing, provide gutters.*	✓	✓	✓
Weathering		*Membrane and flashings shall not split, slip, wrinkle, buckle, blister or erode due to adverse effects of temperature and moisture change, sunlight or atmosphere for not less than 20 years.*	✓	✓	✓
Volume change		*Thermal movement due to ambient temperatures shall be compensated for to permit expansion and contraction without impairment of per formance against weather and moisture.*	✓	✓	✓

Subsystem: 3.0 ROOF/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
3.5 Compatability **General**		*Roof/Ceiling Subsystem shall be designed to interface with other Subsystems involved in the project as required.*	✓	✓	✓
Penetration		*Roof/Ceiling Subsystem shall be capable of accommodating passage of electro-mechanical services either within the floor structure or within a space defined between the structure and the ceiling level.*	✓	✓	✓

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
4.1 General					
Interior finishes	Interior finishes for non-industrial (personnel type) space shall be appropriate for the designed function of the building and spaces. Low maintenance material shall be used to whatever extent possible with selection being based on anticipated use, life cycle cost impact, fire, and other safety requirements and suitability for the environment being created etc. (DOD 5-3)	*Same as DOD*	✓	✓	
Floors	Heat transmission for floors. See Subsystem 2.0 Exterior Walls, Element 2.5 (DOD 9-2.2B)	*Same as DOD*			
4.2 Strength					
Ceiling		*Resist reaction of partitions lateral load (10-15 PSF)*			
Floor general		*Floors shall support all loads including lateral reaction from interior partitions.*	✓	✓	✓
Live Loads:	See:	*Same as Subsystem: 1.0 Structure herein.*	✓	✓	✓
floor	Subsystem 1.0 Structure (DOD 6-3.1)				
wind	Subsystem 1.0 Structure (DOD 6-3.2)				
Dynamic Loads:					
hurricane-typhoon	See 3.2 herein & DOD 6-3.5	*Same as Subsystem: 1.0 Structure herein.*	✓	✓	✓
vibration & seismic	See 3.2 herein & DOD 6-3.1	*Same as Subsystem: 1.0 Structure herein.*	✓	✓	
Floor Surface:					
impact		*Surface shall show no cracking or chipping when tested per MIL-T-1717a, Para. 4.4.4.6 or subsequent revisions (FK 5D.1 Line 29/30)*	✓	✓	
indentation		*Floor surface shall resist permanent indentation from concentrated loads and residual indentation shall not exceed 0.10 inches when tested in accord with Method 3231 of FTMS 501a using a 50 lb. load for 7 days and a 24 hr. recovery period; also simulate design loading per ASTM D-2394-68 or subsequent revisions (FK 5D.1 lines 32-5)*			

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
4.3 Fire Safety		*Hourly ratings for floor/ceiling assemblies above shall meet Fire Resistive Classifications per UL, or tests in accord with ASTM E 119 or subsequent revisions.*			
Floor/Ceiling Assembly	See Subsystem 3.0 (3.3) herein and DOD 12-6.1 and 12-6.2		✓	✓	✓
prot. non-combustible			✓	✓	✓
unprot. non-comb.					✓
Flame Spread:	See Subsystem 3.0 (3.3) herein.				
ceiling		*Flame spread rating of ceiling surface shall not exceed 25. If fully automated sprinkler system provided -200 (GSA Page C.258)*	✓	✓	✓
floor covering	See 4.1 herein. Carpet shall be provided in open *planned dependent school facilities where required for acoustical purposes.* All carpet shall have a flame spread not greater than 75 (ASTM E-84) or a flame propagation index of less than 4.0 (UL 992). (DOD 5-3)	*Flame spread rating of floor covering shall not exceed 200; tested in accord with ASTM E84-67 or subsequent revisions. (See also GSA Page C.203)*	✓		✓
Smoke Generation:	See Subsystem 3.0 (3.3) herein				
ceiling		*Maximum specific optical density of smoke generated by ceiling shall not exceed 100 as determined by ASTM STP 422 (FK 5B.1 line 55).*	✓	✓	✓
		If a fully automated fire protection sprinkler system is provided as a part of the system–the flame spread rating shall not exceed 400 (see GSA Page G203).		✓	
		For housing not to exceed 75 but 150 if fully automated fire protection sprinkler system provided.		✓	
		Maximum specific optical density of smoke generated by ceiling shall not exceed 300 (see GSA PG 204).		✓	
floor covering	Maximum specific optical density of smoke generated by floor covering shall not exceed 300. See ASTM & FK. Refer above.	*Maximum specific optical density of smoke generated by floor covering shall not exceed 100; tested in accord with ASTM STP 422. (FK 5D.1 line 55/56 & 5D.2 lines 01-03)*	✓		✓

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Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Potential Heat		*The limit of combustibility for any square foot of floor/ceiling assembly classed noncombustible, which applies only to the structural part of the assembly and its fire protection, shall be 5000 BTU when tested in accord with ASTM Proceedings · 61.(15)*	✓	✓	✓
4.4 Finish Properties					
Color	Federal Std. No. 595 (DOD 5-2)	*Federal Std. No. 595*	✓	✓	✓
Texture		*No restriction except texture shall not adversely affect compliance with other Properties Standards required herein (FK 5D.2 line 29/30)*	✓	✓	✓
Reflectance:					
ceilings		*Ceilings and the nonluminous parts of integrated lighting/ceilings shall have a reflectance not less than 70% and maximum gloss of 15 measured on a 60 degree Gardner gloss meter (FK 5D.2 lines 32/33).*	✓	✓	
floors		*Floors shall have a reflectance not less than 35%; measured with a Baumgartner type spherical reflectometer (FK 5D.2 lines 35/36)*	✓	✓	
Abrasion Resistance— Floors:					
ceramic tile		*Abrasion resistance shall be equal to or greater than Standards set forth in ANSI A137.1-1967 or subsequent revisions. (FK 5D.3 lines 34/37)*	✓	✓	
floor tile		*Abrasion resistance of all floor tile shall be equal to or greater than standards set forth in Fed. Spec. SS-T-312 Type IV for vinyl asbestos tile. (FK 5D.3 lines 10/12)*			
carpet		*Abrasion resistance shall be tested by 700,000 revs. in a Tetrapad Walker abrasion test and shall result in a rating of not less than 3 (Fair: Moderate abrasion). FK 5D.3 lines 41/43)*	✓	✓	
other surfaces		*Other smooth surfaces shall abrade no more than 0-2.5 cc in a standard 60 cycle test with an Armstrong Abrader (FK 5D.5 lines 36/37).*	✓	✓	

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Stain Resistance—Floors:					
ceramic tile		*Stain resistance shall be equal to or greater than standards set forth in ANSI X137.1-1967 or subsequent revisions (FK 5D.3 lines 34/37)*	✓	✓	
floor tile		*Stain resistance of all floor tile shall be equal to or greater than standards set forth in Fed. Spec. SS-T-312 Type 1 for vinyl asbestos tile. (FK-5D.3 lines 18/20).*	✓	✓	
carpet		*Follow manufacturer's recommended procedures for stain removal; as a general guide to stain removal for carpets see Technical Bulletins T173 and T174 of the National Institute of Rug Cleaning or subsequent revisions.*	✓	✓	
other surfaces		*Stain resistance per ASTM D1308-58 "Effect of Household Chemicals on Floor Finishes," or subsequent revisions.*	✓	✓	
Aging—Floors		*Floor surfaces shall maintain an acceptable level of performance for 10 years under light traffic and for 5 years under heavy traffic when tested in accord with Fed. Spec. SS-T-312a or subsequent revisions (gradual color mellowing is acceptable. (FK 5D.3 lines 14/16)*	✓	✓	
Ultraviolet Resistance—Floors		*Floor surfaces shall have no appreciable color change after 150 hours exposure to 150°F in Atlas Fadeometer. (FK 5D.2 line 36)*	✓	✓	
Moisture—Floors		*Floor surface shall permit no water penetration when tested in accord with Para. 4.4.5 of Fed. Test Method TT-C-0055A or subsequent revisions. (FK 5D.2 lines 50/52)*	✓	✓	
Humidity Resistance:					
group shower room, general laundry room, and similar wet areas		*Floor/ceiling shall have no appreciable deterioration after 400 hrs. exposure to atmosphere with 100% humidity and 100°F temperature. (FK 5D.2 lines 42/44)*	✓	✓	
other areas		*Floor/ceiling shall have no appreciable deterioration after 100 hrs. of exposure to atmosphere of 100% humidity and 100°F temperature. (FK 5D.2 lines 46/48)*	✓	✓	

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Washability:					
floors		*Normal care and maintenance shall not shrink, expand, soften, harden, degrade, weaken, erode or otherwise alter the floor properties herein. (See also GSA PG 215)*	✓	✓	
ceilings		*No softening, color damage nor more than slight surface abrasion when tested with 15,000 brush strokes, wetted by 5% solution of trisodium phosphate in Gardner Straight Line Washability Machine. (See also GSA PG 266)*	✓	✓	
Biological		*Floor and ceiling shall resist attack from fungi, mildew, bacteria, insects, rodents and other organisms. (See also FK 5D.1 lines 40/43)*	✓	✓	
4.5 Acoustics					
Dwelling Areas		*Provide minimum Sound Transmission Class of 4-2 on floors as determined by ASTM E-90 (FK 5D.2 line 12)*		✓	
		Impact Insulation Class values shall equal FHA criteria. Impact Noise Curve, with impact noise reduction of -5 in accordance with 150 R140 (FK 5D.2 line 15).		✓	
Other Occupied Areas		*STC shall be equal to or greater than AIA Chapter 13 (17). IIC shall be equal to or greater than FHA Criteria Impact Noise Curve in AIA Chapter 13 (17) with impact Noise Rating (INR) equal to minus 5 for offices and classrooms STC tested in accord with ASTM E90-66; IIC tested in accord with ISO R140-1960. (21)*	✓		
Absorption-Ceiling		*Noise Reduction Coef. shall be 0.50 to 0.70 at 500 CPS for ceiling when tested in accord with ASTM C423-66 or subsequent revisions (see also GSA PG 240)*	✓		

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
4.6 Compatibility—General	The utilization of building systems—is encouraged—(DOD 1-4.8) Building Systems - An entire facility made up of sub-systems that have a positive interfacing relationship with each other and is designed for an effective combination of production, installation, and performance. (DOD 1-4.8A(1))	*Floor/Ceiling Subsystem shall be designed to interface with other Subsystems herein.*	✓	✓	✓
Penetrations		*Floor/Ceiling Subsystems shall be capable of accommodating passage of electro-mechanical services either within the floor structure or within a space defined between the structure and the ceiling level.*	✓	✓	✓
4.7 Integrated Lighting/Ceiling	—all air conditioned spaces where the general lighting level is 100 foot candles or greater shall have an integrated air conditioning-lighting system — (DOD 8-5.5)	*Integrated lighting/ceiling is a special case of the Floor/Ceiling Subsystem. It shall meet all performance standards specified herein for Floor/Ceiling with regard to strength, fire safety, finish properties, acoustics and compatibility plus the additional requirements set forth henceforth.*	✓		
Additional Requirements:					
strength		*Same as Floor/Ceiling plus support all fixture mountings and electromechanical terminals. See Subsystem: 8.0 Electrical for luminaire support.*	✓		
fire safety		*Integrated lighting/ceiling shall be UL listed as part of a 1 hr. Fire Resistive Classification assembly with the floor, or tested in accord with ASTM E119.*	✓		
		Non-combustible construction as defined in Sec. 101 of NFPA Natl. Fire Code	✓		
flame spread		*Flame spread rating of integrated lighting/ceiling surface shall not exceed 25 when tested in accord with ASTM E84-67 or subsequent revisions.*	✓		
smoke generation		*Same as Floor/Ceiling standards for ceiling surface.*	✓		
potential heat		*Same as Floor/Ceiling*	✓		
acoustics		*Same as Floor/Ceiling*	✓		

Subsystem: 4.0 FLOOR/CEILING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Lighting		*See Subsystem: 8.0 Electrical for lighting standards and references. Luminaires shall be integral with ceiling system, labeled by an approved agency, and shall conform to the inherent modularity of the integrated lighting/ceiling system.*	✓		
Electromechanical		*The integrated lighting/ceiling shall accommodate the requirements imposed by Subsystems 6.0: Plumbing, 7.0: HVAC and 8.0: Electrical for service outlets and terminals. These outlets and terminals shall be integral with the ceiling, labeled by an approved agency, and shall conform to the inherent modularity of the integrated lighting/ceiling system.*	✓		
Compatibility—General		*Same as Floor/Ceiling; in addition the integrated lighting/ceiling shall be a unified system of lighting elements and electro-mechanical outlets/terminals conforming to all standards of performance stated above and designed to interface with other Subsystems herein.*	✓		

Subsystem: 5.0 INTERIOR PARTITIONS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
5.1 General	Painted gypsum wall board			✓	
	Glazed structural units		✓	✓	✓
	Ceramic tile		✓	✓	
	Concrete masonry units		✓	✓	✓
	Plaster			✓	
5.2 Strength					
Lateral Load	10 PSF per DOD (1); 15 PSF when design wind load greater than 40 PSF	*10 PSF (FK 5E.1 line 33)*	✓	✓	✓
Impact		*Per ASTM E72-68 Sections 12 and 13; tests conducted on full-height partition and door not smaller than 3 x 7 feet; instantaneous deflection shall not exceed 1 inch nor permanent set of 1/16 inch after 5 drops of 2 feet. Surface shall show no cracking or chipping when tested per MIL-T-1717A, Para. 4.4.46 or subsequent revisions. (See also FK 5E.1 line 22)*	✓	✓	✓
Attachment Load	Support by bolts or through-bolts.	*Provide support for attachments equivalent to 40 PLF every 2 feet vertically on either or both sides of partition. (FK 5E.1 line 36)*	✓	✓	
5.3 Fire Safety					
Load-bearing:	These elements shall have a minimum of 2 hr. fire rating for fire resistive construction and 1 hr. rating for protected non-combustible construction (DOD 12-6.1).	*As DOD's*	✓	✓	✓
Non-load-bearing	Shall be non-combustible for fire resistive construction (DOD 12-6.20)				
		Hourly ratings for partitions and doors under Section 5.3 herein shall meet Fire Resistance Classifications per UL, or tests in accord with ASTM E119 or subsequent revisions (See FK 5E.1 line 47)	✓	✓	✓
Flame Spread		*Flame spread rating of partition surface shall not exceed 75 when tested in accord with ASTM E84-67 or subsequent revisions (FK 5E.2 line 1).*	✓	✓	✓

Subsystem: 5.0 INTERIOR PARTITIONS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Smoke Generation		*Maximum specific optical density of smoke generated by finished partition surface shall not exceed 100 when tested in accord with ASTM STP 422 or subsequent revisions (FK 5E.2 line 4)*	✓	✓	✓
Potential Heat		*The limit of combustibility for any square foot of partition section classed non-combustible, excluding surface finish, shall be 8000 BTU when tested in accord with ASTM Proceedings 61(15).*	✓	✓	✓
5.4 Finish Properties			✓	✓	✓
Color	Federal Std. No. 595 (DOD 5-2)	*Federal Std. No. 595*	✓	✓	✓
Texture		*No restriction except texture shall not adversely affect compliance with other Properties Standards required herein. (FK 5E.2 line 26)*	✓	✓	✓
Gloss		*Max. gloss rating not greater than 20 when measured by a 60 degree Gardner Gloss Meter. (See also FK 5E.2 line 29).*			
Reflectance		*40 to 60% when measured by Baumgartner reflectometer.*	✓		
Abrasion Resistance:					
plastic laminate		*Wear rate not to exceed 0.08 grams per 100 cycles, and the wear value shall be 200 cycles minimum for the laminates, when tested in accordance with NEMA LD1-201-1964, May 1967. (FK 5E.3 line 25)*	✓	✓	
vinyl wall covering		*No exposure of backing or base when tested in accord with Wyzenbach method, CCC-T-191B, Method 5304, 300 double rubs in circulation areas, 200 double rubs in other areas or subsequent revisions. (FK 5E.3 lines 20/23)*	✓	✓	
all other finishes		*Change in gloss not greater than 5%, measured on a Gardner 60-degree Gloss Meter, when tested using a Gardner Model 105 Washability and Abrasion machine, 150 cycles in circulation areas, 100 cycles in other areas. (FK 5E.2 lines 31/33)*	✓	✓	✓

Subsystem: 5.0 INTERIOR PARTITIONS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
Stain Resistance		*No permanent discoloration or damage by application and removal 24 hrs. later of not more than three of the following: tea, coffee, household bleach, wet detergent, carbon tetrachloride, lipstick, cellulose tape, ballpoint ink, permanent ink (FK 5E.3 lines 09/12)*	✓	✓	
Aging		*No fading or rusting (slight dulling of surface permitted) after 900 hrs. exposure in National Carbon Co. X-1 Weathering Machine. (FK 5E.3 lines 05/07)*	✓	✓	
Ultraviolet Resistance		*No·appreciable color change after 150 hrs. exposure at approx. 150 degrees F. in Atlas Fadeometer. (FK 5E.2 lines 35/36)*	✓	✓	
Humidity Resistance: group shower room, general laundry room, and similar wet areas		*No appreciable deterioration after exposure for 400 hrs. to atmosphere with 100% humidity and 100 degrees F. temperature. (FK 5E.2 lines 44/46)*		✓	
other areas		*No appreciable deterioration after exposure for 100 hrs. to atmosphere with 100% humidity and 100 degrees F. temperature (FK 5E.2 lines 40/42)*	✓	✓	
Washability		*No softening, color change nor more than slight surface abrasion (including joints of laminated surfaces) when tested with brush wetted by 5% solution of trisodium phosphate in Gardner Straight Line Washability machine as follows:*			
circulation areas		*100,000 brush strokes*	✓	✓	
group shower and toilet rooms		*50,000 brush strokes*	✓	✓	
other areas		*15,000 brush strokes (FK 5E.2 lines 50/53; 5E.3 lines 01/03)*	✓	✓	

Perf. Specs

Subsystem: 5.0 INTERIOR PARTITIONS

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
5.5 Acoustics					
Sound isolation:					
dwelling areas		*The interior partition system shall have a minimum Sound Transmission Class (STC) of 42 without doors (FK 5E.2 lines 11/12)*		✓	
other occupied areas		*STC shall be equal to or greater than AIA Chapter 12.*	✓	✓	✓
doors in partitions with required STC of 48 or greater		*Door shall be gasketed and STC not less than 29.*	✓	✓	
doors in partitions with required STC of 32 to 48		*Door STC shall be not less than 24, gasketing optional*	✓	✓	✓
doors in partitions with required STC less than 32		*No STC rating required. STC ratings herein above shall be when tested in accordance with ASTM E90-66, or subsequent revisions.*	✓	✓	✓
5.6 Compatibility					
General		*Interior Partition Subsystem shall be designed to interface with other Subsystems herein.*	✓	✓	✓
Demountability		*When required by the functional program for the facility, Subsystem shall be capable of being disassembled, relocated and re-erected without adverse effect on other Standards herein, and with 90% salvageability*	✓		
Penetration		*Subsystem shall be capable of accommodating passage of electro-mechanical branch services to other Subsystems herein, horizontally and vertically, either within the partition thickness or within cavities formed of similar components.*	✓	✓	

Subsystem: 6.0 PLUMBING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
6.1 General			✔	✔	✔
Code	Plumbing and drainage shall comply with the American Standard National Plumbing Code A40.8 as issued by the ASME and, in general with the Report of the Coordinating Committee for a National Plumbing Code as issued jointly by the Housing and Home Finance Agency and the Department of Commerce. The "National Standard Plumbing Code," latest revision, as suggested by the National Association of Plumbing-Heating-Cooling Contractors may be used as an alternate code provided the materials permitted as options under the code are approved by the headquarters construction engineering office of the using military department. Plumbing fixtures shall conform generally to Federal Specification WW-P 541d. For uniformity and identification, all references to features shall be indicated by the symbols given in Joint-Service Manual TB 700-1, NAVFAC P-268 and AFM 160-15 "Construction and Material Schedule for Military Medical and Dental Facilities" (DOD 10-1.1).	*Same as DOD, i.e., American Standard National Plumbing Code ASA A40.8-1955.*			
Fixture Allowance	Chapter 10, Article 10-1.2, Tables 10-1, 10-2, 10-3, 10-5 and 10-7 provide fixture determination methods for Administrative Facilities, Bachelor Officer Quarters, Barracks and Dormitories, Storage & Educational Development.	*Same as DOD, with Classroom-Type Training Facilities governed by Table 10-7.*	✔	✔	✔

Pert. Specs.

AD-A034 131 CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAI--ETC F/G 13/13
AN INTERIM GUIDE TO INDUSTRIALIZED BUILDING SYSTEMS.(U)
JAN 76 S T LANFORD, T D CSIZMADIA, D BRYANT

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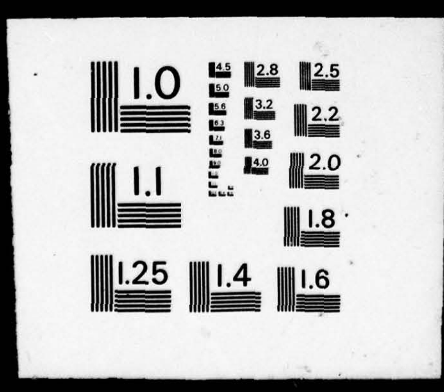

Subsystem: 6.0 PLUMBING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
6.2 Structural Effect					
Deflection		*This Subsystem shall accommodate deflections permitted in other Subsystems herein.*	✓	✓	✓
Loads		*This Subsystem shall be unaffected by dead loads and service loads imposed on it and by it, including impact loads, static and dynamic fluid loads, temperature change and unrelieved installation stresses, as follows:* no horizontal change in slope nor vertical direction change, from design directions, in excess of 1/8 inch/LF. no loss of stability or tightness sufficient to impair essential function or permit leakage. No adverse effects on other Subsystems herein.	✓	✓	✓
Support	Lavatories in central toilets shall be of enameled cast iron and shall be of the built-in type. Wall hung lavatories shall not be used. (DOD 10-1.2B)	*Function of plumbing fixtures and integrity of supports and attachments shall be unaffected when supporting a load of 300 pounds placed at midpoint of front rim and in center of sump.*	✓	✓	✓
6.3 Safety					
Fire		*Elements of this Subsystem penetrating or contained within other Subsystems herein shall not impair the fire resistance standards of those Subsystems.*	✓	✓	✓
Sprinklers	DOD Chapter 12, subparagraphs 12-2.1 provides for automatic sprinkler systems for certain facility types and conditions of occupancy or contents.	*When required by the functional program for the facility, automatic sprinkler system shall meet the requirements of the NFPA No. 13-1969 or subsequent revisions.*	✓		✓
Freezing	Water and waste piping shall not be located in exterior walls or in attic spaces where there is a danger of freezing. (DOD 10-1.2C)	*Whenever subjected to freezing conditions of predictable frequency and duration, this Subsystem shall be insulated or otherwise protected from damage or impairment of essential function.*	✓	✓	✓

Subsystem: 6.0 PLUMBING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
6.4 Fixtures					
Design Criteria	Plumbing fixtures, including lavatories, shall be grouped for economy in all toilet, shower and laundry rooms. Plumbing fixtures shall be scheduled on the basis of the planned peacetime (rated) capacity, and shall not be scheduled in excess of that in Tables 10-1 through 10-7 without the prior approval of the Deputy Assistant Secretary of Defense (Installations and Housing) (DASD-1 & H) (DOD 10-1.2)				
Plumbing Fixtures (for land use)	Federal Specification WW-P-541d	*Same as DOD*	✓	✓	✓
Enameled Cast Iron		*Commercial Std. 77-63*	✓	✓	✓
Staple Vitreous China		*CS 20-63*	✓	✓	
Earthware (vitreous glazed)		*CS 111-43*	✓	✓	
Formed Metal Porc. Enam. Sanitary Ware		*FS-WW-P-541b*	✓	✓	✓
Drinking Fountains		*ANSI Z4.2-1942*			
Gel-coated Glass-fiber-reinforced Polyester Resin:				✓	
bath units		*ANSI Z124.1-1967*	✓	✓	✓
shower stall units and receptors		*ANSI Z124.2-1967*			
Flush Valves		*Lever-type, neoprene diaphragm, 39 inches above floor.*			
6.5 Acoustics					
Sound Isolation		*This Subsystem shall neither compromise nor prevent attainment of the STC (Sound Transmission Class) Standards required for other Subsystems herein.*	✓	✓	✓
Noise Level		*Noise level resulting from this Subsystem shall not exceed NC-40.*		✓	

Subsystem: 6.0 PLUMBING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
6.6 Modular Units (defined as factory-produced fixture components and enclosures, site assembled or factory assembled, forming partial or complete bathrooms or private toilet rooms)			✓	✓	
Non-integrated Enclosures		*Space elements not integrated with fixture components shall be governed by the Standards for Subsystem: 5.0 Interior Partitons herein with respect to Flame Spread, Smoke Generation, Potential Heat, Finish Properties and Acoustics.*			
Plastic Units:					
tests		*Modular units composed of gel-coated glass-fiber reinforced polyester resins or thermo-formed acrylics shall meet test requirements in accordance with ANSI Z124.1 and 2-1967 or subsequent revisions for the following:* *Drain fitting* *Threshld and bottom* *Area impact* *Point impact* *Water absorption* *Water resistance* *Color fastness* *Stain resistance* *Surface test* *Cleanability and wear* *Standard dirt test*			
flame spread		*Flame spread raing shall not exceed 235 when tested in accordance with ASTM E84-67, or within one inch line-out when tested in accordance with ASTM D635-56T, or subsequent revisions.*			
Safety-Acoustics		*Modular units shall neither compromise nor prevent attainment of STC, NC or Fire Resistance Classification Standards required for other Subsystems herein.*			

Subsystem: 6.0 PLUMBING

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
6.7 Compatibility	Ample space shall be provided for piping and particular care shall be taken to avoid structural interferences and conflicts between the several types of mechanical and electrical work. (DOD 10-1.2C)	*Plumbing Subsystem shall be designed to interface with other subsystems herein.*	✓	✓	✓

Subsystem: 7.0 HVAC

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
7.1 General	Chapter 8, Articles 8-1 through 8-8 provides for determination of eligibility and mechanical criteria for air conditioning, evaporative cooling and dehumidification; and mechanical criteria for heating and mechanical ventilation, including design factors, economic considerations and descriptions and considerations for subsystems and components.	*Unless otherwise stated herein, minimum Recommended Standards for this Subsystem shall be governed by DOD, insofar as its requirements are expressed in terms of measurable performance (e.g., Subparagraph 8-5.1 and 8-5.2, but exclusive of such specific design solutions implied therein which may limit the economic utilization of alternate methods of conformance with these Standards (e.g., Subparagraph 8-5.3)*	✓	✓	✓
7.2 Structural Effect			✓	✓	✓
Deflection		*This Subsystem shall accommodate deflections permitted in other Subsystems herein.*			
Load transmission		*Static and dynamic loads arising from this Subsystem shall be transmitted with no adverse effect on Subsystem: 1.0 Structure herein.*	✓	✓	✓
7.3 Safety					
Personnel	Mechanical ventilation systems shall be designed, installed and protected in accordance with the "ASHRAE Guide and Data Book" or "Industrial Ventilation, a Manual of Recommended Practice." Mechanical ventilation and exhaust systems for flammable, hazardous and toxic gases or fumes shall follow the codes of practice of the NFPA. (DOD 8-7.1)	*This Subsystem shall be designed to afford protection to occupants and operating personnel in accord with applicable current requirements of ABA, ANSI, ASME, NFPA and UL.*	✓	✓	✓
Fire		*This Subsystem shall be designed in accordance with requirements of NFPA Std. 90A, or subsequent revisions.*	✓	✓	✓

Subsystem: 7.0 HVAC

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
7.4 Acoustics					
Sound Isolation		*This Subsystem shall neither compromise nor prevent attainment of the NC (Noise Criterion) or STC (Sound Transmission Class) Standards required for other Subsystems herein.*	✓	✓	
Noise Level		*Noise level resulting from this Subsystem, when supplying air at 3 CFM/sq. ft. to occupied areas, shall not exceed:* *dwelling areas:* NC-40 *offices, classrooms:* NC-35	✓	✓	
7.5 Air Pollution	Air pollution from military installations shall be held to a minimum, and abatement provided in accordance with DOD Instruction No. 4120.9 or subsequent revisions.	*Design of this Subsystem shall conform to the applicable requirements of local, state or national authority having jurisdiction at the site of the Facility, whichever is more stringent.*	✓	✓	✓
7.6 Durability	In order to avoid corrosion problems, no air conditioning equipment, including roof top units, shall be installed on the roof of a building within two miles of the ocean. (DOD 8-5.10)	*Fixed central subsystems with motors and/or pumps shall have a service life of not less than 15 years; non-accessible elements, e.g., piping shall have a service life equal to the facility in which installed.*	✓	✓	✓
7.7 Maintainability		*This Subsystem shall be designed and installed to permit repair or replacement readily during its service life, and without removal of other elements or Subsystems for access.*			
7.8 Compatibility		*HVAC Subsystems shall be designed to interface with other Subsystems herein.*	✓	✓	✓

Subsystem: 8.0 ELECTRICAL

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
8.1 General					
Codes	Electric lighting and power systems within buildings and facilities shall be installed in accordance with NEC as published by NFPA, as a minimum standard (DOD 7-2.1) Exterior systems and facilities in accordance with NESC and NEC (DOD 7-3.1)	*Same as DOD, i.e., design of this Subsystem shall be in accordance with the National Electrical Code NFPA No. 70-1966 or subsequent revisions.*	✓	✓	✓
Standards:					
lighting	The design of interior, exterior and sports lighting shall be in accordance with fundamentals and recommendations of the IES Lighting Handbook, published by IES subject to modifications and clarifications for implementing these criteria so noted in DOD 7-1.2 thru 7-1.6 (DOD 7-1.1)	*Same as DOD, i.e., lighting design and intensities for this Subsystem in accordance with IES (24) for dwelling areas and IES (25) for other locations.*	✓	✓	✓
	Maintenance lighting intensities except as herein modified shall conform to the intensities established in the current edition of the IES Lighting Handbook. (DOD 7-1.2) *Note:* In some instances the names of facilities in common use by DOD are not the same as names of similar facilities given in the IES tables. For comparison see DOD 7-1-2B.		✓	✓	✓
luminaires	Generally, shall be standard commercial type and shall conform to UL Publication No. 57, Standard for Electric Lighting Fixtures (DOD 7-1.8)	*Same as DOD*	✓	✓	✓
materials and equipment	Conform to Federal Specifications or standards of UL, NEMA, IEEE and ANSI. (DOD 7-2.4)	*Same as DOD*	✓	✓	✓
Installation Requirements	For special installation requirements see DOD 7-1.7.	*Same as DOD*	✓	✓	✓

Subsystem: 8.0 ELECTRICAL

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
8.2 Structural Effect					
Deflection		*This Subsystem shall accommodate deflections permitted in other Subsystems herein.*	✔	✔	✔
Load transmission		*Static loads arising from this Subsystem shall be transmitted with no adverse effect on other Subsystems herein, including connections capable of transmitting 5 times the dead weight of lighting elements without failure.*	✔	✔	✔
8.3 Safety					
Fire		*Elements of this Subsystem penetrating or contained within other Subsystems herein shall not impair the fire resistance Standards of those Subsystems.*	✔	✔	✔
Flame spread		*Flame spread rating of non-metallic parts of lighting elements shall not exceed 25 when tested in accord with ASTM E84-67 or subsequent revisions.*	✔	✔	✔
Smoke Generation		*Maximum specific optical density of smoke generated by non-metallic parts of lighting elements shall not exceed 300 when tested in accord with ASTM STP 422(14) or subsequent revisions.*	✔	✔	
Emergency Lighting	Required for certain areas where continuance of operation or protection of life or property is essential (See DOD 7-1.3)	*When required by the functional program for the facility, emergency lighting system shall meet the requirements of NFPA No. 101-1966 or subsequent revisions.*	✔	✔	✔
Automatic Fire Alarm	Required for one and two-story combustible dormitory type wing quarters, including male and female BEQ's and BOQ's and similar buildings used for sleeping purposes (DOD 12-2.3)	*Shall meet requirements of NFPA No. 71-1970 and NFPA No. 72A-1967 or subsequent revisions.*		✔	
Manual Fire Alarm	Required for Barracks, Dormitories, Bachelor Officer Quarters without automatic alarm housing 20 or more persons and Administration Buildings and Schools having an occupancy of 50 or more persons (See DOD 12-2.4)	*Shall meet requirements of NFPA No. 71-1970 and NFPA No. 72A-1967 or subsequent revisions.*	✔	✔	
Exit Lighting	Shall conform to NFPA Life Safety Code (DOD 7-1.4)	*Same as DOD, i.e., NFPA No. 101-1966 or subsequent revisions.*	✔	✔	✔

Subsystem: 8.0 ELECTRICAL

Elements/Characteristics	Current DOD Criteria	Recommended Standards	ADM/CLR	Housing	Storage
8.4 System Characteristics	Shall be selected to provide for most efficient and economical distribution of energy. (DOD 7-2.2)	*Same as DOD*	✓	✓	✓
8.5 Acoustics					
Sound Isolation		*This Subsystem shall neither compromise nor prevent attainment of the STC (Sound Transmission Class) Standards required for other Subsystems herein.*	✓	✓	✓
8.6 Maintainability	Adequate, clear space shall be provided around switchboards, panel boards, transformers, switchers, and controllers for normal maintenance and operation. Adequate clearances shall be maintained from floor to bottom of wall or ceiling mounted equipment such as annunciators, clocks, lighting fixtures, etc. so as not to interfere with passage of personnel or equipment. Panel boards and cabinets located in narrow passages or corridors shall be recessed. (DOD 7-2.6)	*This Subsystem shall be designed and installed to permit repair or replacement readily during its service life and without removal of other elements or Subsystems for access.*	✓	✓	✓

SECTION TWO

SAMPLE PERFORMANCE SPECIFICATION

TABLE OF CONTENTS

2:320 GENERAL DESCRIPTION

Following is an example of a performance specification for a typical subsystem of a building. The structure of other subsystems requirements can be interpolated from this spec as can the wording and general approach.

Since this subsystem is only one part of a building system for which a single source proposal is sought, the wording does not represent a separate prime contract specification. Statements which are common to all sections are referenced as being included in Division 1 (General Requirements) fo the RFP/RFTP.

With the Fixed Design Strategy, this specification has to be supplemented with partition layout drawings which the other three strategies do not require.

The specification is in abbreviated or short format. Where the long-form specification is preferred, extend the wording as from an outline spec, but holding to the same structure.

2:321 SAMPLE PERFORMANCE SPECIFICATION: INTERIOR PARTITIONS

PART 1 - GENERAL

1.01 Description

A. Intent:

1. To establish basic performance criteria for industrialized non-bearing interior partitions.
   - a. Set minimum quality level.
   - b. Imply no particular materials or methods.
   - c. Equal or exceed industry standards.
   - d. Encourage use of new materials and designs.

B. Definition:

1. Vertical elements separating interior spaces:
   - a. Visually
   - b. Acoustically
   - c. Safely
   - d. With doors and frames.
   - e. With reinforced openings for services.
   - f. Accept attachments.
2. Referenced industry standards:
   - a. ANSI: American National Standards Institute
   - b. ASTM: American Society for Testing and Materials
   - c. MIL: Military Specifications
   - d. NFPA: National Fire Protection Association
   - e. UL: Underwriters' Laboratories, Inc.

C. Scope:

1. Install complete and in place:
   - a. Partitions
   - b. Door frames
   - c. Doors
   - d. Service openings
2. Include back-up facilities as required:
   - a. Plant
   - b. Equipment
   - c. Materials
   - d. Labor
   - e. Research
   - f. Development
   - g. Testing
3. Install door hardware specified elsehwere.
4. Provide and store extra stock.

D. Related Work Specified Elsewhere:

1. Floors: Division 3.
2. Walls: Division 4.
3. Door Hardware: Division 8.
4. Ceilings: Division 9.
5. Flooring: Division 9.
6. Mechanical Services: Division 15.
7. Electrical Services: Division 16.

1.02 Quality Assurance

A. Qualifications:

1. Five (5) years experience.
2. Competent installers.
3. Experienced supervisors.

B. Requirements of Regulatory Agencies:

1. Approval by local Building Departments.

C. Mock-up:

1. Refer to Division 1.
2. Erect at on site location provided by Owner.
3. Demonstrate:
   - a. 15-foot straight run.
   - b. Interface with other surfaces.
   - c. Interface with mechanical and electrical services.
   - d. 2, 3, and 4-way corner intersections.
   - e. Door and frame.
   - f. Finished end.
   - g. Repeated door slamming.
   - h. Impact of 200 lb. person.
   - i. Repeated pounding by 200 lb. person.
   - j. Amateur-applied latex-base paint.
4. Mock-up alternate:
   - a. Inspection Tour of existing building:
     1. Accurate example of proposed project.
     2. Assume costs of tour group.
     3. Meet all mock-up requirements.

D. Laboratory Certified Test Reports:

1. Refer to Division 1.
2. Submit reports for:
   a. Acoustics
   b. Impact
   c. Fire
   d. Abrasion

E. Shop Drawings:

1. Refer to Division 1.
2. Drawings all show:
   a. Interface with floor
   b. Interface with ceiling.
   c. Interface with wall.
   d. 2, 3 and 4-way corner intersections.
   e. Door and frame construction.
   f. Finished end.
   g. Erection and disassembly procedures.
   h. Method of marking attachment.
   i. Floor plan layouts.
   j. Elevations.
   k. Locations of services.

F. Samples:

1. Refer to Division 1.
2. Samples shall consist of:
   a. Partition construction
   b. Door construction
   c. Door frame construction
   d. Finishes
   e. Colors

1.03 Submittals

A. Maintenance Manuals:

1. Refer to Division 1.
2. Six copies in hard-bound covers including:
   a. Erection, disassembly instructions.
   b. Maintenance instructions.
   c. Repair instructions.
   d. Parts list.

1.04 Product Handling

A. Ship, store and handle:

1. Free of damage.
2. On schedule.
3. To maintain availability.

1.05 Job Conditions

A. Coordinate:

1. Between trades.
2. With other Contractors.
3. To maintain schedule.

1.06 Guarantee

A. Requirements

1. Refer to Division 1.
2. Two (2) years for doors.

PART 2 - PRODUCTS

2.01 Design Requirements

A. Materials

1. New
2. Good quality
3. Equal or exceed industry standards.

B. Acoustics

1. STC ratings per ASTM-E90-66T.
   a. Continuous runs of partition: 40
   b. Partitions with corner joints: 35.
   c. Partitions with door: 25.

C. Temperature

1. No appreciable deterioration after 96 continous
   a. 30°F.
   b. 130°F.

D. Humidity

1. No appreciable deterioration after 96 continuous hours of exposure at 70°F. and:
   a. 10% R.H.
   b. 90% R.H.

SAMPLE SPEC.

Part Specs

2:32
Sample Spec.
03

E. Color and Texture

1. Surface strength, gloss, reflectance and wear:
   a. No appreciable deterioration after 250 dry rub cycles with a Gardner Straight Line Washability Machine.
   b. Color as per Federal Standard No. 595.

F. Durability.

1. Lateral Load
   a. No damage and no permanent deflection from horizontal 10 lbs. per square foot force over entire vertical surface on one side of partition.
2. Accessory Load
   a. No damage and no permanent deflection from attachment of 40 lbs. per lineal foot on one side of partition.
3. Deflection; ASTM E72-68
   a. Maximum instantaneous deflection of 1 inch in drop of 2 feet.
   b. Maximum permanent set of ⅛ inch in drop of two feet.
4. Impact
   a. No surface cracking or chipping from 3 feet drop of 8 oz. 1½-inch ball.
5. *Biological*
   a. Partitions shall deter fungi, mildew, bacteria, insects and rodents.

Fire Rating

1. Surface or finish
   a. Flame spread: 15 or less.
   b. Fuel contributed: 15 or less.
   c. Smoke developed: 0.
2. Complete assembly:
   a. UL fire resistance classification of 1 hour.
   b. NFPA classification of noncombustible.

H. Dimensions

1. Height: Variable from 7 feet to 10 feet.
2. Width: Interlocking incremental units or continuous.
3. Thickness: Not more than 4 inches.
4. Variations: Dimensions shall be adjustable and adaptable to irregular building conditions encountered.

I. Weight

1. Not more than 40 lbs. per lineal foot.

J. Interface

1. Secure to adjoining floors, ceilings, columns and walls.
2. Effective continuous light- and sound-sealed joints.
3. Services:
   a. Electrical: Accommodate vertical and horizontal runs of ¾-inch nominal size thin wall conduit with attached outlet boxes.
   b. Plumbing:
      1. Capable of forming horizontal and vertical pipe chases.
      2. Capable of supporting standard wall-hung type features.

K. Tolerances:

1. Thickness: 4" maximum
2. Height: Floor to ceiling
3. Surface Irregularities: Plus or minus 3/16"
4. Surface slope: Maximum ⅛" in 8'-0"
5. Joint, corner, end slope: Maximum ⅛" in 8'-0"

L. Appearance:

1. Visual acceptance by Architect and Owner:
   a. *Substantial and rigid.*
   b. Straight and plumb.
   c. Pleasing, uniform color rendition.
   d. Cohesive composition and texture.
   e. Surface stability.
   f. Satisfactory interface arrangement.
2. No exposed unfinished edges.

PART 3: EXECUTION

3.01 Inspection

A. Existing Conditions
   1. Verify readiness.
   2. Review project progress schedule.

3.02 Preparation

A. Coordination
   1. Schedule work activities.
   2. Coordinate all trades.

B. Field Measurements:

1. Confirm space allotments and requirements.

2. Measure locations of interfacing surfaces.

C. Methods

1. In accordance with manufacturer's recommendations.

2. In conformance with these specifications.

3. As required to pass field tests.

4. As scheduled.

3.04 Field Quality Control

A. Workmanship

1. Finished work shall be:

a. Secure
b. Plumb
c. Durable
d. Attractive

B. Tests:

1. On finished work.

2. By independent testing laboratory.

3. One of each test for every 200 lineal feet.

a. Acoustics
1. Prove STC ratings.
b. Durability
1. Prove lateral load of 1 PSF.

3.05 Adjust and Clean

A. Alignment

1. Straight

2. Level

3. Plumb

B. Clean

1. Free of dirt, dust and smudges.

3.06 Extra Stock

A. Component Parts:

1. Any piece, part or device weighing less than 200 lbs.

2. The greater number of five (5) or one percent (1%).

B. Store:

1. In protective wrapping.

2. Marked with full identification.

3. In location furnished by Owner.

3.07 Schedules and Drawings:

A. Schedules:

1. Refer to attached schedules for doors and accessories.

B. Drawings:

1. Following drawings are included in the Contract.

chapter four

INFORMATION SOURCES

TABLE OF CONTENTS

SECTION ONE

INDUSTRIALIZED BUILDING: A BIBLIOGRAPHY

TABLE OF CONTENTS

2:410 SCOPE

This list of documents supplements specific references throughout the Guide. The references are listed in approximately the order of importance and are categorized under these headings:

- Housing
- Administration/Classroom Facilities
- Storage Facilities
- General
- Fixed Design Strategy

2:411 HOUSING

Author	Title/Publication	Date	Comment	Address
Caudill Rowlett Scott	*RFP for the Fort Knox BOQ*	1972		*1111 West Loop South (or Box 22427) Houston, Texas*
SUNY	*Brockport RFTP*	1971		*1111 West Loop South (or Box 22427) Houston, Texas*
	Performance Criteria	1971		
Heery & Heery	*RFTP for the FY 72 AF/IB Program,*	1972	Housing, Two-Step	*880 West Peachtree Street, N.E. Atlanta, Georgia*
	RFTP for the FY 73 AF/IB Program,	1973	Housing, BOQ's, TBEQs, Two-Step	*880 West Peachtree Street, N.E. Atlanta, Georgia*

2:412 ADMINISTRATION/CLASSROOM FACILITIES

Heery & Heery	*RFTP for the FY 72 AF/IB Program, OPS/ADMIN/TRAINING*	1972	Two-Step	*880 West Peachtree Street, N.E. Atlanta, Georgia*
ABS	*Educational Facilities Manuals*	1971	Helpful in planning and budgeting subsystems	R. Clayton Kantz, Dir. Academic Building Systems 2150 Shattuck Ave., Suite 414 Berkeley, Cal. 94704
GSA/PSB	*Performance Concept for Office Buildings,*	1971	Two-Step	*Public Building Service General Services Administration Washington, D.C. 20405*
	Construction Contracting Systems	1970	A description of flexible contracting procedures	
	Test Method: Speech Privacy Potential Objective Measurements			
	Test Method: Speech Privacy Potential Subjective Judgements		A package of acoustic documents, helpful in open planning schemes.	
	T 4-13500 Guide Specimen: Integrated Ceiling and Background System	1973		
	Achieving Acoustical Privacy in Open Office Space	1973		
EFL	*Systems: An Approach to School Construction*	1971		
	SCSD: The Project and the Schools		Excellent description of how the pioneering school systems programs were accomplished	
BSIC	*History and Evaluation of the SCSD Project*			
	Building Systems Planning Manual	1971		
	Manufacturer's Compatibility Study	1971		
BOSTCO	*Introduction to Tract III*	1971	Educational Facilities	*Robert J. Vey, Dir., BOSTCO Public Facilities Dept., Boston, Mass. 02101*

2:413 STORAGE FACILITIES

Heery & Heery	*RFTP for the FT 72 AF/IB program: WAREHOUSING*	1972	Two-Step	*880 West Peachtree Street, N.E. Atlanta, Georgia*

2:414 GENERAL: KEY REFERENCES

CERL	*Study of Industrialized Building, (3 volumes)*	1971	Good survey of industrialized building systems.	*Box 4005 Champaign, Illinois*
OCE	*Two-Step Manual*	1972		*Forrestal Building Washington, D.C.*
National Bureau of Standards	*Performance Concept in Buildings* No. 361 (Two volumes)	1972		
National Science Foundation	*Performance Code Study*	1971		*1800 G. St. N.W. Washington, D.C. 20550*
BRAB/FCC	*The SubSystem Concept of Building Construction, No. 62*	1970	A description of the possible strategies	
MBM	*Project Management, An Example*	1970	Progress report on the management of a large building project.	*McKee, Berger, Mansuedo 575 Hoylston St. Boston, Mass. 02116*
IF	*Thesaurus of Building Science and Technology,* *Industrialization Forum,* published every 10th week	1972	Articles, updated references and abstracts on systems building	*Industrialization Forum School of Architecture Box 1079 Washington Univ. St. Louis, Mo. 63130*
BSIC	*Newsletter*, published every 10th week		News of open systems projects.	
VA	*Hospital Building Systems,* (Three Volumes)	1968 -71	The construction of multi-story buildings with large bays as basic units.	
IBS	*Mental Health Facilities Performance Specs*	1970		*International Building Systems, Inc. 2905 Maple Avenue Dallas, Texas 75201*

2:415 FIXED DESIGN STRATEGY

SSP	*Contract Documents*		Information on Florida school projects.	*Floyd T. Christian, Supt. Schoolhouse Systems Project State Dept. Of Education Tallahassee, Fla.*
SEF	*Contract Documents*		Description of programming findings	*Peter D. J. Tirian, Tech. Dir. Study of Educational Facilities 155 College Street Toronto 2B, Ontario, Canada*

SECTION TWO

USER NEEDS: A BIBLIOGRAPHY

TABLE OF CONTENTS

2:421 USER NEEDS: CERL REPORTS

Following are abstracts of CERL studies which investigated unique *user needs* for military buildings.

BRAUER, R.L.,
SURVEY OF SOLDIERS' ATTITUDES TOWARD TROOP HOUSING, CERL (unpublished report), January, 1973.

Abstract:

Major results of this survey identify how enlisted men view their barracks' conditions, which conditions they wished changed, and how attitudes about barracks are affected by background demographic factors.

On 18 topics covered, the troops were most dissatisfied with the appearance and atmosphere of the sleeping area. Over 80% preferred to live off-post. Ratings on 145 conditions are presented, together with a ranking of how important it is to change each condition. Major attitude differences about barracks are shown to be a function of the number of people per room and related factors such as age, paygrade, and intent to reenlist.

Recommendations are made for utilizing the information from the study in improving present conditions, in new barracks construction, and in evaluating the effectiveness of improvements.

Order From:

CERL-SPB, Box 4005
Champaign, Ill. 61820

DINNAT, R.M., and W. GIBBS,
COST EFFECTIVENESS OF THREE DIFFERENT INTERIOR OPEN/TYPE OFFICES,
CERL Technical Report D-2, March 1973.

Abstract:

Three different open-type interior office environments at CERL—the *Action office*, the *GSA Partition office*, and the *Open-Plan Office*, all containing the same kinds of research activities—were evaluated with respect to cost-effectiveness.

Measures of performance and physical resources were compared: performance was measured indirectly through the occupants' attitudes about their offices; for cost-effectiveness the offices' effectiveness ranks were compared with their cost per occupant.

Results: the *Action* and *Open-Plan* offices were more cost-effective than the *GSA Partition* office, though no such determination could be made between the *Action* and *Open Plan* offices; while the *Action* office provided more effectiveness at a higher cost per occupant, the *Open Plan* office provided less effectiveness at a lower cost per occupant.

Order From:

CERL-SPB, Box 4005
Champaign, Ill. 61820

DRESSEL, D.L., and R.L. BRAUER,
INITIAL REPORTS ON SYSTEMIZING INFORMATION TO IDENTIFY AND RELATE BEHAVIORAL AND PHYSICAL DESIGN PARAMETERS, CERL Preliminary Report D-4, March 1973.

Abstract:

An information system to identify and classify human needs in the military facility is being developed to assist design decisions. Behavioral and design theories have helped formulate the pilot information system. To be responsive to requirements of both researcher and designers, data is categorized and translated through the "relationship sentence." Amenable to computer storage and data retrieval, the relationship sentence is thought to be complete enough for gathering of data from existing studies, yet sufficiently flexible to allow categorization of behavioral data in varying degrees of explicitness. Output from the system is intended to be compatible with developing computer-aided design parameters, if not an integral part of such programs.

Also given: The structure and function of the information system, its relationship to information science and computer-aided architecture, and work required for its further development.

Order From:

CERL-SPB, Box 4005
Champaign, Ill. 61820

HINTZ, Major N.C., and R.W. CRAMER,
DECOR CATALOG FOR DINING FACILITIES,
CERL Technical Report D-1, November 1972.

Abstract:

These interior design concepts for dining facilities can assist commanders in implementing Army dining facilities improvements. Designs are intended to improve the soldiers' dining environment by alleviating things he considers undesirable—drabness, noise, crowdedness and lack of privacy. Although designs are limited to the dining area and are tailored to existing building types, the concepts are adaptable to new construction.

This publication may serve as a design and planning guide for a variety of coordinated decor packages. Included are dining facility layouts, an illustrated furniture and accessory index, correlation and cost data, color schemes, renderings of typical completed facilities, and comprehensive instructions to catalog users.

Catalog revisions are periodically issued for new materials and techniques.

Order From:

CERL-SPB, Box 4005
Champaign, Ill. 61820

GIBBS, W., and R.W. CRAMER,
DINING FACILITY USER-ATTITUDE SURVEY AND ENVIRONMENTAL DESIGN RESEARCH AT TRAVIS AFB, CALIFORNIA,
CERL Preliminary Report D-5, April 1973.

Abstract:

User satisfaction with the social and physical environments of three dining facilities at Travis Air Force Base, California is outlined in three stages and a program of implementation is presented in chronological sequence. Performance and re-

sults of the first and second stages are documented.

Research Stage 1: Measurement of user's attitudes and behaviors in three existing dining environments. Data was collected from 296 questionnaires, 125 interviews, time-lapse photography, and trained observers. Results were analyzed using the Pearson Product Moment correlation coefficient (r) as a measure of the degree of relationship existing between the attitude measures and the measured behaviors.

Research Stage 2: Development of renovation designs. Resulting relationships were translated into design-usable statements (or hypotheses). Negative attitudes were linked to specific key stations of the existing facility. These attitude-key station hypotheses provided bases for the development of specific design intentions.

Research Stage 3: An outlined post-renovation evaluation should substantiate the effect of renovation on user satisfaction. Also presented: methodology and techniques to be employed in a *convenience-decor package* experiment to evaluate specific modifications with respect to cost-satisfaction-effectiveness.

Order From:

CERL-SPB, Box 4005
Champaign, Ill. 61820

2:422 USER NEEDS: AF/IB FY72 HOUSING

In the RFTP prepared for the AF/IB, FY72 Housing Program, the following paragraphs were included to help the proposer understand the basic user needs for which he should design. The footprint strategy was used in this building program.

Order From:

Heery & Heery
880 West Peachtree Street, N.E.
Atlanta, Georgia

or

Corps of Engineers
FWD (AF Section)
819 Taylor Street
Fort Worth, Texas 76102

Air Force Policy for Bachelor Housing: It is the policy of the Air Force to provide on-base housing for all bachelor enlisted personnel through the first four grades (85% of all bachelor enlisted personnel are in this category) and for officers through to the rank of Captain. This represents a significant departure from past policies in that the higher ranking, older personnel are no longer required to live on base. However, the Air Force provides housing for enlisted and officer personnel of higher grades when accommodation is not available in the civilian community.

Bachelor Officers Quarters: The typical bachelor officer is between the age of 22 and 27. He is highly educated, having had first a college education and then extensive Air Force training. As an officer and an individual, he views his quarters in much the same way that a civilian of equal socio-economic standing would view an apartment. The bachelor officer's quarters is a place in which the officer can unwind from the events of the day, unhampered by physical or institutional restrictions. It is a place where he can relax in private whether reading a book, watching television, or listening to his stereo. It is also a place in which he may choose to socialize with fellow officers or visiting friends who may or may not be part of his complex. In addition to the identity and freedom that is essential for each particular officer's unit, the officers' dormitory complex itself must reflect the individual's needs as well as that of the group.

Bachelor Enlisted Quarters: A typical airman is 17 to 22 years old, has a fundamental need for self-assertion, and requires a living space for the expression of his personality. Although there are some changes occurring, the Air Force is still a highly regimented institution for the young airman. He is more affluent than his historical peers. He owns his own television, stereo system, radio, etc., and normally keeps them in his living quarters. He generally uses the shared lounge area for activities of a group nature, or when the privacy of his sleeping area is compromised by the presence of a roommate with a non-mutual friend or friends. The use of a dormitory facility by airmen spans the use-spectrum from 'a place to sleep' to 'a substitute home,' all based on the needs and personal preferences of the individual airman. A typical group of airmen is a true cross-section of the youth of America. They come from cities, farms, suburbia; they are rich, poor, and middle class; their education can vary from PhD's to 8th grade. The more residential the dormitory appears, especially with respect to the interior, the better the airman will relate to the dormitory and the Air Force environment.

2:423 USER NEEDS: NON-MILITARY EXPERIENCE

Following are descriptions of other IBS projects where **user requirements** are used as one basis for developing performance specifications.

University Residential Building System

The URBS program initiated by the University of California had **user requirements** as one criterion on which the building system was developed. An example:

> "The outstanding student requirements were for quiet and personal privacy, thus denoting the need for improved visual and acoustical separations as well as greater ability for the individual to shape and control the environment, at least within his own room. Other top priority requirements were: improved study provisions, more adaptable environments in terms of thermal, acoustical, and lighting levels; more

storage space of all kinds; more adequate ventilation with individual controls; and sufficient electrical power."

"The ability to use and store a wide array of electrical appliances within student rooms was requested (i.e., guitar, coffee pot, clocks, toothbrush, hair dryer, typewriter, tape recorder, record player, radio, and TV)."

"Students requested group areas which are functionally sized and environmentally appropriate for study, recreation, hobbies, cultural and social activities. They felt that large lounges on the ground floor are non-functional. Thermal and ventilation conditions were a common cause of complaint, especially in toilet rooms. Students agreed that in a mixed community of non-smokers, it is important that the air be kept moving and clean and that windows be openable. Interior decoration should be more subject to control by the occupants to provide better opportunity for individual expression within the residential environment."

Order From:

R. Clayton Kantz, Dir.
Building Systems Projects, U. of C.
2150 Shattuck Ave., Suite 414,
Berkeley, Calif. 94704

State University of New York/Brockport RFP

SUNY's Dormitory Authority incorporated **user requirements** into their turnkey project. An example of these requirements, presented to proposers, follows:

"All Study/Bedrooms should respond to the following requirements:
- the need for individual privacy;
- the need for an atmosphere conducive to intense study
- the need to express personality;
- the need for social interaction at various levels."

Order From:

Caudill, Rowlett & Scott
1111 West Loop South
(or P. O. Box 22427)
Houston, Texas

Academic Building Systems

The ABS program is a joint effort by the Indiana University and the University of California to provide adequate facilities for increasing student enrollment within limited building budgets. **User requirements** are identified for science and engineering buildings through the following techniques:
- identification of the users;
- description of the activities which would occur in these facilities;
- organization of activity patterns and space requirements;
- recording of reactions to the existing built environments similar to those proposed for the new facilities (categories discussed included subjective and social aspects, the laboratory, special environments, and the classroom);
- compilation of components of the built environment (safety, security, odor and acoustics).

Order From:

R. Clayton Kantz, Dir.
Building Systems Projects, U. of C.
2150 Shattuck Ave., Suite 414,
Berkeley, California 94704

Student Housing, Education Facilities Laboratories

This EFL publication includes a chapter, "What do students want?" Subsequent chapters describe contemporary physical solutions which attempted to respond to these "wants."

Order From:

EFL
477 Madison Avenue
New York, New York 10022
($2.00/copy)

SECTION THREE

DATA BANKS AND INFORMATION SERVICES

TABLE OF CONTENTS

2:430 SCOPE

This section contains instructions on how to obtain information on the different aspects of industrialized building. The first two sub-sections describe information services provided by CERL. The CERL/TIBS Data Bank provides *technical information* on systems, while the CERL/IBIS Data Bank is a *computerized bibliography* on industrialized building. Additional sub-sections contain descriptions and user procedures from still other data banks and resource agencies.

2:431 CERL/TIBS: A data bank on manufacturers, AEs, and CMs

CERL/TIBS is the abbreviation for **Construction Engineering Research Laboratory/Technical Information on Building Systems.** Information on available building systems is categorized into general and building subsystem information. *CERL's 1974 survey of IBS manufacturers will provide information on their building parts, identified as subsystems by BSIC/EFL:*

foundations
structure
roofing
interior partitions
exterior walls
HVAC
lighting/ceiling
sprinklers
electrical
plumbing
carpeting

Information on the most important characteristics of each subsystem is available. For example, the information collected on interior partitions may include:

materials
finishes
flexibility
sound transmission
fire resistance
flamespread

An example of the computer printout which *you could expect to receive after requesting* information on system manufacturers from CERL/TIBS follows. (This service is currently available only to District Engineers and other Corps personnel).

2:432 CERL/IBIS DATA BANK

CERL/IBIS is a code name for an IBS *computerized bibliography*. It is possible to request a printout of titles pertinent to a particular research subject. This information service is optional and is not an integral part of any procedures outlined in the guide. While the service is primarily for Corps and military use, it may be used by outside interests at a minimal charge.

Address request as follows:
CERL-FMM, Box 4005
Champaign, Illinois 61820
Telephone AC 217 352 6511
"Please send printouts from
CERL/IBIS based on these keywords:

____

____

____

CERL/IBIS is based on a data bank called Industrialized Building Information System, *set up by Harold L. Jenkinson, (University of Illinois, Urbana, Illinois, August 1972). The name should not be confused with the IBIS (Issue-Based Information System) developed at the University of California (Berkeley).*

The reference system is set up so that each document, whether periodical article or book, is listed under one or more keywords. There are three types of keywords:

Common keywords, which describe the subject matter of the book;

Proper name keywords, which are either the name of the author or the name of a person who is the main concern of the publication (e.g., to obtain a printout of data base entries written about or by *Paul Rudolph*, submit the keywords **RUDOPA;** the printout will contain all stored titles on Paul Rudolph.)

Periodical keywords, which are condensed from the titles.

The computer can perform three types of searches and will print out entries responding to:

- a single keyword search request;
- at least one of several keywords in a search request; or
- all keywords in a single search request.

When the printout of the titles is received, the books or periodicals can be obtained from libraries or through interlibrary loans.

Keyword Abbreviations:

To reduce key words to 8 characters or less, vowels have been generally dropped, with the exception of the first character. Consonants are retained sufficiently to suggest the structure of the word.

Following is a complete list of CERL/IBIS keywords, categorized under **common, proper name**, and **periodical** headings.

```
**********************************************************************
PAGE A MANUFACTURER PROFILE
2
 SERVICES
 THE FIRM ENGAGES IN THE FOLLOWING ACTIVITIES:
            DESIGN OF COMPLETE BUILDING SYSTEMS
            MANUFACTURE OF COMPLETE SYSTEMS
            SITE ERECTION OF COMPLETE SYSTEMS
            DESIGN OF BUILDING COMPONENTS
            MANUFACTURE OF BUILDING COMPONENTS
            INSTALLATION OF BUILDING COMPONENTS
            CONSTRUCTION MANAGEMENT
            SALES OF BUILDING SYSTEM TO ERECTOR
            SITE WORK
            GENERAL CONTRACTING
3
 DELIVERY
 MAX ECON DIST BETWEEN HDQRTRS(OR PROD FACILITY)AND JOB SITE:
    98 MILES

 ZIP CODES OF HDQRTRS(OR PROD FACILITY)USED FOR ABOVE DISTANCE:
   12345
   54321
    9998
    9999
   59990

            THE PRODUCT IS NOW COMPLETELY DEVELOPED AND AVAILABLE
4
 PRODUCTS
 THE FIRM SUPPLIES, DESIGNS, OR INSTALLS THE FOLLOWING...
            ...AS PART OF A COMPLETE SYSTEM:
                  FOUNDATIONS
                  STRUCTURAL SYSTEM
                  EXTERIOR WALLS
                  H.V.A.C.
                  ELECTRICAL
                  LIGHTING SYSTEM
                  CEILING SYSTEM
            ...PREFABRICATED AND SOLD SEPARATELY:
                  FOUNDATIONS
                  STRUCTURAL SYSTEM
                  EXTERIOR WALLS
                  H.V.A.C.
                  PLUMBING SYSTEM
                  ELECTRICAL
                  LIGHTING SYSTEM
                  CEILING SYSTEM
            ...PROVIDED AS NON-SYSTEMS WORK:
                  FOUNDATIONS
                  STRUCTURAL SYSTEM
                  H.V.A.C.
                  PLUMBING SYSTEM
                  ELECTRICAL
                  LIGHTING SYSTEM
            ...NOT SUPPLIED:
                  FOUNDATIONS
                  STRUCTURAL SYSTEM
                  H.V.A.C.
                  PLUMBING SYSTEM
                  ELECTRICAL
                  LIGHTING SYSTEM
            ANSWERED: DON'T KNOW
                  EXTERIOR WALLS
                  ROOFING SYSTEM
                  ROOFING SYSTEM
                  ROOFING SYSTEM
                  ROOFING SYSTEM
                  PLUMBING SYSTEM
                  CEILING SYSTEM
5
 PROCUREMENT
 METHODS PREFERED FOR SELLING PRODUCTS TO GOVERNMENT:
            DIRECTLY
            THROUGH ANY BUILDING DEVELOPER
            THROUGH A FRANCHIZED DEALER
            THROUGH ANOTHER MANUFACTURER OF BUILDING MATLS OR SUPPLIES
            CATALOG
            CEILING CONTRACTOR
6
 BUILDING TYPE:
            PERMANENT
            RELOCATABLE
            TEMPORARY
            CLASSROOM
            MAINTENANCE
            LABORATORY
            MEDICAL
            WAREHOUSE
            OFFICE
            GYMNASIUM
            SINGLE FAMILY DETACHED
            TOWN HOUSE
            HIGH RISE APARTMENT
            DUPLEX
            MOBILE HOME
            DORMATORY
            HOTEL/MOTEL
            DINING HALL
            RETAIL SALES
            CHAPEL
            PARKING GARAGE
            BANK FACILITIES
7
 CODES AND STANDARDS
            THE FOLLOWING CODES OR STANDARDS PERMIT USE OF THE PRODUCT:
                  BOCA BUILDING CODE
                  SOUTHERN BUILDING CODE
                  DOD MANUAL OF CONSTRUCTION
            THE FOLLOWING CODES OR STANDARDS PROHIBIT USE OF THE PRODUCT:
                  UNIFORM BUILDING CODE
                  U.L. CODES
            ANSWERED: DON'T KNOW
                  NATIONAL PLUMBING
**********************************************************************
PAGE B EXPERIENCE
```

```
1
LAST YEAR'S BUSINESS VOLUME IN INDUSTRIALIZED BUILDINGS:
$12345,000
2
             PRODUCTS HAVE BEEN USED IN BUILDINGS QUALIF FOR FHA OR VA INSUR
3
BUILDING PRODUCTS OR SERVICES HAVE BEEN USED IN FACILITIES FOR:
             US ARMY
             US AIR FORCE
             US NAVY/MC
             H.U.D.
             G.S.A.
             OTHER FEDERAL
****************************************************************************
PAGE C STRUCTURE
1
STRUCTURAL TYPES PROVIDED:
             FRAME AND INFILL
2
DIMENSIONS                          MAXIMUM        OPTIONAL        MINIMUM
PRIMARY SPAN (FT/IN)                  /           OK /  OK        123/    0
SECONDARY SPAN (FT/IN)              12/   34      56/   78         91/   23
FLOOR TO FLOOR (FT/IN)            OK /  OK          /                /   OK
CANTILEVER (FT/IN)              >   97/    0       0/    0          0/    0
PLANNING MODULE (FT/IN)             12/   34      56/   78         91/   29

CLEAR AREA (SC FT)                              OK                123
ROOF PITCH (IN 12 FT)                1           2                  3
TOTAL HEIGHT (STORIES)              12          34                 56
3
MATERIALS (PER STRUCTURAL MEMBER)
COLUMN             ANODIZED ALUM.        OAK
BEARING WALLS      FIBERGLS BATTS        ALUM.     STEEL
FLOOR              BRASS
ROOF               DON'T KNOW
4
FOUNDATIONS
APPROPRIATE FOUNDATION TYPES:
             CONCRETE SPREAD FOOTING
             CAISSONS OR PILES
             POURED CONCRETE WALLS
             CONCRETE BLOCK WALLS
             PEIRS AND GRADE BEAMS
5
LOADING
LIVE LOAD   (POUNDS/SQ FT)
          MAXIMUM            DELTA=SPAN/240          DELTA=SPAN/360
FLOOR       123                  456                     789
ROOF        123                  456                     789
WIND LOAD    12                  345                     678

METHOD OF RESISTING LATERAL FORCES:
             MOMENT FRAME
             SHEEP WALLS
             CROSS BEARING WALLS
             OTHER
6
FIRE PROTECTION (PER STRUCTURAL MEMBER)
                         RESISTANCE (HRS)             PERFORMANCE TESTS
```

```
COLUMN                    VARIES                  CONDUCTED BY OUTSIDE AGENCY
BEARING WALL            > 9.970                   CONDUCTED IN HOUSE
FLOOR/ROOF                7.890                   PLANNED OR DESIRED
****************************************************************************
PAGE D EXTERIOR WALLS
1
GENERAL INFORMATION
            YES:
                      EXTERIOR WALLS LOAD BEARING?
                      AIR INFILTRATION <.6 CFM/HR/SQ FT?
                      INTEGRATED WITH CONCEALED ELECTRICAL APPARATUS?
            NO:
                      PRE-FABRICATED PANELS?
                      WATER PENETRATION TESTED?
            ANSWERED: DON'T KNOW
                      INTEGRATED WITH PLUMBING SUBSYSTEM?
2
MATERIALS
INTERIOR SURFACE      ANODIZED ALUM.       OAK
CORE (STRUCTURAL)     P.O.S.               FIBERGLS BATTS
CORE (INSULATION)     ALUM.   STEEL        BRASS
EXTERIOR SURFACE      CONCRETE-UNSPEC.     PRESTR. CONCRETE
3
THERMAL CONDUCTIVITY
                     RATING 'U'               PERFORMANCE TESTS
SOLID PORTION        0.123                   NOT PLANNED
GLAZED PORTION       4.560                   CONDUCTED BY OUTSIDE AGENCY
4
OPENINGS
WINDOW FRAMES CAN BE:
              WOOD
              ALUMINUM
              STEEL
              PLASTIC

SASH CAN BE:
              OPERABLE
              FIXED

GLAZING MATERIAL CAN BE:
              S.S.
              D.S.
              PLATE
              INSULATING
              HEAT ABSORB
              PLASTIC
5
FIRE PROTECTION
                             RATING           PERFORMANCE TESTS
FIRE RESISTANCE (HRS)        1.220            CONDUCTED IN HOUSE
FLAME SPREAD (OAK=100)     455.000            PLANNED OR DESIRED
SMOKE DEVELOPED            788.000            NOT PLANNED
6
ACOUSTICS- SOUND TRANSMISSION
                          RATING (STC)        PERFORMANCE TESTS
SOLID PORTION             12.000              PLANNED OR DESIRED
GLAZED PORTION            45.000
****************************************************************************
        ROOFING
```


04

```
7
 GENERAL INFORMATION
          YES:
                    PRE-FABRICATED PANELS?
          NO:
                    ROOF SCALABLE?
8
 MATERIALS
 CORE (STRUCTURAL)ANODIZED ALUM.      OAK
9
 FIRE PROTECTION & THERMAL CONDUCTIVITY
                   RATING                        PERFORMANCE TESTS
 FIRE RESISTANCE   12.300                     DON'T KNOW
 CONDUCTIVITY ("U")  0.123                    DON'T KNOW
**********************************************************************
PAGE E INTERIOR PARTITIONS
1
 GENERAL INFORMATION
          YES:
                    PREFABRICATED PANELS?
                    INTEGRATED WITH PLUMBING SYSTEM?
                    PORTABLE?
          NO:
                    LOAD BEARING?
                    DEMOUNTABLE?
                    OPERABLE?
          ANSWERED: DON'T KNOW
                    INTEGRATED WITH ELECTRICAL SYSTEM?
2
 MATERIALS (PER ELEMENT)
 FINISH            ANODIZED ALUM.      OAK
 BEARING SURFACE   FIBERGLS BATTS      ALUM.    STEEL
 CORE              BRASS               FELT
3
 STRUCTURAL
                   HORIZONTAL LIVE LOAD 5 PSF OR MORE
4
 DIMENSIONS
 MODULE DIMENSIONS FOR PRE-FABRICATED PANELS (FT/IN)
 DIMENSION         MINIMUM        MAXIMUM         INCREMENT
 WIDTH              /             DK /  DK          /  DK
 HEIGHT           12/   34        56/   78        91/  23
 THICKNESS          /  DK           /             DK /  88
5
 OPENINGS
 DOOR FRAMES MAY BE:
             WOOD
             STEEL
             ALUMINUM
             PLASTIC

 DOOR TYPES AVAILABLE:
             WOOD HOLLOW CORE
             CLASS B FIRE DOOR
             HOLLOW METAL
             WOOD SOLID CORE
             CLASS C FIRE DOOR
6
 FIRE PROTECTION
```

```
                        RATING                       PERFORMANCE TESTS
 FIRE RESISTANCE        12.300
 FLAME SPREAD                                     NOT PLANNED
 SMOKE DEVELOPED         DK                       CONDUCTED BY OUTSIDE AGENCY
7
 ACOUSTICS
                        RATING                       PERFORMANCE TESTS
 PARTY WALL             12.000                    PLANNED OR DESIRED
 WALL WITH DOOR         12.000                    PLANNED OR DESIRED
 NON-PARTY WALL         12.000                    PLANNED OR DESIRED
**********************************************************************
PAGE F    H.V.A.C.
1
 GENERAL INFORMATION
          YES:
                    INTEGRATED WITH CEILING SYSTEM?
                    HEATING & COOLING IN ONE DISTRIBUTION SYSTEM?
                    TERMINAL UNITS?
                    VARIABLE VOLUME?
                    OPERATING COST INFORMATION CAN BE PROVIDED?
          NO:
                    INDIVIDUALLY CONTROLLED ZONES?
                    SELF CONTAINED UNITS?
                    CONSTANT VOLUME?
                    ZONED (INDIVIDUALLY CONTROLLED)?
2
 ENERGY SOURCE
          FOR HEATING:
                    OIL
          FOR A/C:
                    ELECTRICITY
                    COAL
          FOR BOTH:
                    NATURAL GAS
          ANSWERED: DON'T KNOW
                    L.P. GAS
3
 ZONES
 MINIMUM SIZE OF SINGLE INDIVIDUALLY CONTROLLED ZONE:
  123 SQ FT

 MAXIMUM NUMBER OF ZONES:
 GREATER THAN 97
4
 ACOUSTICS (USING ASTM E-90 TESTS)
          ANSWERED: DON'T KNOW

          NOT ACTUALLY TESTED
5
 ENERGY CONVERSION (HEATING)
          FORCED AIR
          HOT WATER
          STEAM
          ELECTRIC RADIATION

**********************************************************************
       PLUMBING
6
 GENERAL INFORMATION
          YES:
```

```
                    PREFABRICATED PLUMBING WALL?
          NO:
                    PREFABRICATED "WET MODULE?"
7
WET MODULE
WET MODULES INCLUDE:
           BATHROOM
           KITCHEN
           LAUNDRY
           H.V.A.C.
           STORAGE
           ELECTRICAL DISTRIBUTION
8
MATERIALS
WASTE PIPE       ANODIZED ALUM.       OAK
VENT PIPE        FIBERGLS BATTS       ALUM.   STEEL
HOT WATER PIPE   BRASS                FELT
GAS PIPE         ANODIZED ALUM.       OAK
WATER CLOSET     FIBERGLS BATTS       ALUM.   STEEL
LAVATORY         BRASS                FELT
SHOWER           ANODIZED ALUM.       OAK
TUB              FIBERGLS BATTS       ALUM.   STEEL
URINAL           FIBERGLS BATTS       ALUM.   STEEL
LAUNDRY SINK     ANODIZED ALUM.       OAK
**********************************************************************
PAGE G CEILING
1
GENERAL INFORMATION:
           APPLIED DIRECTLY TO THE STRUCTURE
           SUSPENDED
           INTEGRATED WITH LIGHTING SYSTEM
           INTEGRATED WITH H.V.A.C. SYSTEM
           INTEGRATED WITH PARTITION SYSTEM
           PROVIDES ACCESS TO CONCEALED SERVICES
2
MATERIALS
STRUCTURE        ANODIZED ALUM.       OAK
FINISH
           ANSWERED: DON'T KNOW
3
ACOUSTICS
             STC RATING                          PERFORMANCE TESTS
CEILING-FLOOR    12.000                        PLANNED OR DESIRED
CEILING-ROOF     12.000                        PLANNED OR DESIRED
4
DIMENSIONS:PLANNING MODULE (IP)
                            BASIC:       123 X  OK
SUBDIVISIONS OF THE BASIC MODULE:        123 X  321
                           AND/OR:       980 X
5
FIRE PROTECTION
                  RATING                         PERFORMANCE TESTS
FIRE RESISTANCE    12.300                      CONDUCTED IN HOUSE
FLAME SPREAD                                   PLANNED OR DESIRED
SMOKE DEVELOPED   123.000                      NOT PLANNED
           CEILING WILL ACCOMODATE A SPRINKLER SYSTEM
**********************************************************************
      LIGHTING
6
```

```
GENERAL INFORMATION
           INCANDESCENT
           FLUORESCENT
           LUMINOUS CEILING
           EXTERIOR LIGHTING
           SAFETY LIGHTING (FIRE,EXIT)
7
LIGHTING LEVELS
LEVEL          # OF 40 WATT TUBES/BASIC MODULE
 70 F.C.                   23
 100 F.C.              GREATER THAN 57 TUBES
           ANSWERED: DON'T KNOW
**********************************************************************
PAGE N STRUCTURE
2
GENERAL INFORMATION
MECHANICAL ACCESS- THE LARGEST DUCT CAPABLE OF PASSING THROUGH THE:
                      RECT                        ROUND
PRIMARY MEMBERS:      12 X  OK                    > 97
SECONDARY MEMBERS:    12 X   34

           STRUCTURE HAS A VERTICAL PLANNING MODULE INCREMENT

           TRUE FOR EXTERIOR WALL:
                 PART OF SUBSYSTEM, ACTS AS SUPPORTIVE STRUCTURAL ELEMENT
           NOT TRUE FOR EXTERIOR WALL:
                 PART OF SUBSYSTEM, PROVIDES NO STRUCTURAL PURPOSE
           OPTIONAL FOR EXTERIOR WALL:
                 CAN BE SUPPLIED WITH THE STRUCTURAL SUBSYSTEM
3
SUBSYSTEM IMPLEMENTATION- USUAL RESPONSIBILITIES OF PARTICIPANTS
(FOR A TYPICAL PROJECT)
           OWNER:
                 PREPARE LAYOUTS
                 PURCHASES
           A-E:
                 PREPARE LAYOUTS
           MANUFACTURER:
                 PREPARE LAYOUTS
                 MANUFACTURE/FABRICATE
                 PURCHASES
                 SITE ASSEMBLY & INSTALLATION
           OTHER MANUFACTURER:
                 PREPARE LAYOUTS
                 MANUFACTURE/FABRICATE
                 PURCHASES
                 SITE ASSEMBLY & INSTALLATION
           CONTRACTOR:
                 PREPARE LAYOUTS
                 MANUFACTURE/FABRICATE
                 PURCHASES
                 SITE ASSEMBLY & INSTALLATION
           OTHER:
                 PREPARE LAYOUTS
                 MANUFACTURE/FABRICATE
                 PURCHASES
                 SITE ASSEMBLY & INSTALLATION
**********************************************************************
PAGE O H.V.A.C.
2
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GENERAL INFORMATION
HEATING OUTPUT= 123 MBH

              ANSWERED: DON'T KNOW

CONTROL ZONES/UNIT: GREATER THAN 57

AIR VOLUME=  12345 CFM/UNIT

              UNITS LOCATED:
                      ON ROOFTOP
                      OTHER
              UNITS NOT LOCATED:
                      ABOVE CEILING
              OPTIONAL UNIT LOCATIONS:
                      IN EQUIPMENT SPACE
3
 SUBSYSTEM IMPLEMENTATION- USUAL RESPONSIBILITIES OF PARTICIPANTS
 (FOR A TYPICAL PROJECT)
              OWNER:
                      PREPARE LAYOUTS
                      PURCHASES
              A-E:
                      PREPARE LAYOUTS
              MANUFACTURER:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
                      PURCHASES
              OTHER MANUFACTURER:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
                      PURCHASES
              CONTRACTOR:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
                      PURCHASES
              OTHER:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
                      PURCHASES
              ANSWERED: DON'T KNOW
                      SITE ASSEMBLY & INSTALLATION
                      SITE ASSEMBLY & INSTALLATION
****************************************************************************
PAGE P PARTITION
2
 GENERAL INFORMATION
 PLANNING MODULE: HORIZONTAL= 123 INCHES

                    VERTICAL:   >557 INCHES

RELOCATABILITY: RATE=  123 LIN.FT./MANHOUR

              MOVED BY:
                      PARTITION MNF. PERSONNEL
              NOT MOVED BY:
                      SKILLED CRAFTSMEN
              ANSWERED: DON'T KNOW
                      OWNER'S MAINT. STAFF
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 SUBSYSTEM IMPLEMENTATION- USUAL RESPONSIBILITIES OF PARTICIPANTS
 (FOR A TYPICAL PROJECT)
              OWNER:
                      PREPARE LAYOUTS
                      PURCHASES
              A-E:
                      PREPARE LAYOUTS
              MANUFACTURER:
                      PREPARE LAYOUTS
                      PURCHASES
              OTHER MANUFACTURER:
                      PREPARE LAYOUTS
                      PURCHASES
              CONTRACTOR:
                      PREPARE LAYOUTS
                      PURCHASES
              OTHER:
                      PREPARE LAYOUTS
                      PURCHASES
              ANSWERED: DON'T KNOW
                      MANUFACTURE/FABRICATE
                      MANUFACTURE/FABRICATE
                      MANUFACTURE/FABRICATE
                      MANUFACTURE/FABRICATE
****************************************************************************
PAGE Q LIGHTING/CEILING
2
 GENERAL INFORMATION
              ASSEMBLY TYPES INCLUDE:
                      FLAT PANEL
              ASSEMBLY TYPES DO NOT INCLUDE:
                      COFFER (3-D)
              OPTIONAL ASSEMBLY TYPES:
                      LUMINOUS CEILING

 ACCOMODATION OF THE PARTITION SUBSYSTEM:
              ON PLANNING MODULE LINE ONLY

              AIR HANDLING ACCOMODATIONS INCLUDE:
                      AIR HANDLING FIXTURE
              OPTIONAL AIR HANDLING ACCOMODATIONS:
                      DIFFUSER
              ANSWERED: DON'T KNOW
                      AIR BAR
3
 SUBSYSTEM IMPLEMENTATION- USUAL RESPONSIBILITIES OF PARTICIPANTS
 (FOR A TYPICAL PROJECT)
              OWNER:
                      PREPARE LAYOUTS
                      PURCHASES
              A-E:
                      PREPARE LAYOUTS
              MANUFACTURER:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
                      PURCHASES
                      SITE ASSEMBLY & INSTALLATION
              OTHER MANUFACTURER:
                      PREPARE LAYOUTS
                      MANUFACTURE/FABRICATE
```

08


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            PURCHASES
            SITE ASSEMBLY & INSTALLATICN
      CONTRACTOR:
            PREPARE LAYOLTS
            MANUFACTURE/FABRICATE
            PURCHASES
            SITE ASSEMBLY & INSTALLATION
      CTHER:
            PREPARE LAYOUTS
            MANUFACTURE/FABRICATE
            PURCHASES
            SITE ASSEMBLY & INSTALLATICN
************************************************************************
PAGE R ELECTRIC/ELECTRONIC
2
 GENERAL INFORMATICN
           FUNCTIONAL SYSTEMS INCLUDED:
                AUDIO COMMUNICATIONS
                SECURITY
                POWER DISTRIBUTICN
           FUNCTIONAL SYSTEMS NCT INCLUDED:
                CLOCK
                PAX EMERGENCY TELEPHONES
           CPTICNAL FUNCTICNAL SYSTEMS:
                CLOSED CIRCUIT TV
                DAIL ACCESS PROGRAMS
           ANSWERED: DON'T KNOW
                TV ANTENNA
 THE FOLLOWING CAN MOVE UNITS FOR SUBSYSTEMS WITH RELOCTBL SERV COLS:
           MANUFACTURER'S PERSONNEL
           LICENSED ELECTRICIANS
           CWNER'S MAINT STAFF
3
 SUBSYSTEM IMPLEMENTATION- USUAL RESPONSIBILITIES OF PARTICIPANTS
 (FOR A TYPICAL PROJECT)
           CWNER:
                PREPARE LAYOUTS
                PURCHASES
           A-E:
                PREPARE LAYOUTS
           MANUFACTURER:
                PREPARE LAYOUTS
                MANUFACTURE/FABRICATE
                PURCHASES
                SITE ASSEMBLY & INSTALLATICN
           CTHER MANUFACTURER:
                PREPARE LAYOUTS
                MANUFACTURE/FABRICATE
                PURCHASES
                SITE ASSEMBLY & INSTALLATION
           CCNTRACTOR:
                PREPARE LAYCLTS
                MANUFACTURE/FABRICATE
                PURCHASES
                SITE ASSEMBLY & INSTALLATICN
           CTHER:
                PREPARE LAYCLTS
                MANUFACTURE/FABRICATE
                PURCHASES
```

A list of **Common** Keywords

abstracts	ABSTRC
adhesives	ADHSVS
aerospace industry	ARSPIND
aesthetics	AESTHC
air conditioning	AIRCDTG
aircraft industry	AIRCRIND
air leakages	AIRLKGS
aluminum structures	ALSTRC
analysis (mathematical)	ANLYSMTH
applications	APPLCTNS
architects	ARCHS
architectural design	ARCHDS
architectural education	ARCHEDUC
area (surface)	AREA
asbestos cement	ASBCMT
assembly methods	ASBYMTH
assistance	ASSTNC
attitudes (consumer)	ATTCNS
automation	AUTOMTN
behavioral aspects	BHVASP
bibliographies	BIBLIO
books	BOOKS
box assemblies	BXASBY
brick, see masonry, brick	
bridges (structures)	BRDGSTRC
building codes	BLDCODS
building design	BLDDS
building economics	BLDECN
building process	BLDPRCS
building products	BLDPRD
building science	BLDSCNC
building sites	BLDSIT
building spaces	BLDSPC
building systems	BLDSYS
building trades, see unions (trade and labor)	
cable nets	CBLNTS
cables (ropes)	CBLSROP
calculating equipment	CLCEQP
cathode ray tubes (computers)	CRTCMPTR
ceramics	CERAM

certification	CRTF
changes	CHNGS
characteristics	CHRTC
checklists	CKLST
civil engineering	CIVENGR
classification	CLSFCTN
clearances	CLRNCS
climatic conditions	CLMTCDTN
climatology	CLMTLGY
closed systems	CLSYS
coatings	CTNG
codes, see building codes	
coding	CDNG
combinations (mathematics)	CMBNMTH
comfort	CMFRT
communication	CMMCTN
communication systems	CMMSYS
comparison	CMPRSN
competition (business)	CMPBUS
component compatibility	CMPNTCP
components	CMPNTS
computer aided design	CMPTRADS
computer graphics	CMPTRGRP
computer programming	CMPTRPRG
computer programs	CMPTRPGM
computers	CMPTRS
concept coordination	CNCPCRD
concepts (general)	CNCPTGNL
concrete panels	CNCPNLS
concrete (poured-in-place)	CNCPIP
condensation	CNDNSTN
conferences	CNF
constraints	CNSTRNT
construction industry	CNSIND
construction machinery	CNSMCH
construction management	CNSMGMT
construction materials	CNSMTL
consulting services	CNSLSRV
consumer resistance, see attitudes (consumer)	
consumption	CNSPTN
continuity	CNTNY
contract documents	CNTDOC

contractors	CNTR
contractual arrangements	CNTRARR
control	CNTRL
cooperative housing	CPTVHSG
coordinate indexing	CRDNTNDX
cost planning	CSTPLNG
costs	CSTS
critical numbers	CTCLNBR
critical path method	CPM
curriculum	CRRM
curtain walls	CRTWLL
cybernetics	CYBRNTC
data bases	DTBS
defects	DFCT
definitions, see terminology	
demands, housing	DMDHSG
demonstration projects	DMSTPRJ
density	DNSTY
design competition	DSCMPTN
design criteria	DSCRTR
design process	DSPRCS
development	DVMT
dimensional coordination	DMCRDN
directories	DRCTRY
directories (manufacturer & producers)	DRCTYMFR
disposable housing	DSPHSG
documents	DCMT
doors	DRS
drawings	DRWGS
dual graphs	DLGRPH
durability	DRBLTY
economic development	ECNDV
economic factors	ECNFAC
economies of production	ECNPRD
economics	EDNS
education	EDUC
educational facilities	EDUFAC
electrical systems	ELSYS
employment	EMPLYMT
engineering design	ENGRDS

engineering education	ENGREDUC
environmental controls	ENVRCN
environmental design	ENVRDS
environments	ENVRMTS
equipment (tools)	EQPTLS
estimates	EST
evaluation	EVL
expandable buildings, see flexibility (adaptation)	
experimental design	EXPDS
explosions	EXPLO
external envelopes	EXTENV
fabrication (on site)	FBNST
failures	FLR
feedback	FDBK
fiberglass, see plastics	
fieldwork (training)	FLDWKTRN
filing	FLNG
films (motion picture)	FLMS
financing	FNCG
fire prevention	FRPRV
fires	FRS
fire safety	FRSFT
flexibility (adaption)	FLXADP
floor systems	FLSYS
flow charts	FLCHRT
forecasting	FRCSTG
formats	FRMTS
foundations (building)	FDTNBLD
geometry	GMTRY
geotechnics	GEOTCH
government policies	GOVPOL
graphs	GRPH
health facilities	HLTHFAC
heating	HTG
hierarchies	HRCHS
history	HIST
home building	HOMBLD
home ownership	HOMOWN
hospitals	HOSP
housing	HSG
housing needs	HSGNDS
human behavior	HMNBHV
indexes (documentation)	INDXDC
indexes (ratio)	INDXRT
indexing	INDXG
industrial design	INDS
information	INFO
information centers	INFOCTR
information dissemination	INFODSM
information handling	INFOHDLG
information retrieval	INFORTRV
information services	INFOSRV
information systems	INFOSYS
information theory	INFOTHR
information vehicles	INFOVHC
innovation	INNVTN
insulating materials	INSLMTL
insurance	INS
internal subdivisions	INTRNSBD
international	INTL
joining (process)	JNG
joint configurations	JTCNFG
joint movement	JTMVT
jointing	JTG
jointing products	JTGPRD
joints (junctions)	JTS
keyword indexing	KWDINDXG
keywords	KWDS
labor unions, see unions (trade and labor)	
laminated wood, see wood (laminated)	
law (legislation)	LAW
learning curve	LRNGCRV
legislation (political)	LGPOL
libraries	LIB
lightweight structures	LWTSTRC
low-cost housing	LWCSTHSG
locate	LOCATE
magnetic tape	MGTP
maintenance	MAINT
management	MGMT
management methods	MGMTMTH
manufacturers and producers, see directories (manufacturers and producers)	
market aggregation	MKTAGGR
marketing	MKTG
masonry (brick)	MSNRYBRK
materials handling	MTLSHND
measurement	MEAS
mechanical engineering	ME
mechanical equipment	MEQ
mechanical properties	MPRP
mechanical systems	MSYS
medical equipment	MEDEQ
merchandising, see marketing	
methodology	MTHDLGY
method study	MTHSTDY
metric system	MTSYS
migrant worker housing	MGRTHSG
mobile home industry	MOBHOMIN
mobile homes	MOBHOM
model cities program	MDLCTYPR
models	MDLS
modular coordination	MODCRDN
modular housing, see modular structures	
modular structures	MODSTRC
multipurpose buildings	MPBLD
networks (communication)	NTWKCMM
new towns	NWTWNS
nonproprietary systems	NPRPTYSY
objectives	OBJ
office buildings	OFFBLD
operation breakthrough	OPBRKTH
one-stage joints	1STGJTS
on-line (systems)	ONLNSYS
open systems	OPSYS
operations research	OPRS
operators (personnel)	OPTR
optimization	OPTMZN
organizational behavior	ORGBHV
organizational structure	ORGSTRC

organization	ORGN
organizing	ORGG
panel construction systems	PNLCNSYS
paper housing	PPRHSG
performance	PRF
performance specifications	PRFSPC
performance standards	PRFSTD
periodicals	PRDCL
pert	PERT
plastics	PLSTC
plumbing systems	PLBGSYS
plywood	PLYWD
pneumatic structures	PNUSTRC
pollution	PLLTN
portable housing	PTBLHSG
postwar housing	PSTWRHSG
precast concrete	PRCNC
pre-engineered buildings	PRENGBLD
prefabricated foundations	PRFBFDTN
prefabricated wartime housing	PRFBWHSG
prefabrication	PRFB
preferred dimensions	PRFDM
probability theory	PRBTHRY
problem decomposition	PRBLMDCM
procedures	PRCDR
producers, see directories (manufacturers and producers)	
product development	PRDDV
product information	PRDINFO
production (on-site)	PRDSIT
production capacity	PRDCPTY
production management	PRDMGMT
production methods	PRDMTH
productivity	PRDTVTY
professional personnel	PRFPRS
professional practice	PRFPRC
profits	PRFTS
properties of materials	PRPMTL
programming language	PRGLNG
proprietary products	PRPTYPRD
proprietary systems	PRPTYSYS
prototype housing	PRTYPHSG
public administration	PBLCADM
quality	QLTY
quality control	QLTYCNT
quantity surveying	QTYSRVY
rain penetration	RAINPEN
rationalized building	RTZBLD
refrigerating	RFRG
regional planning	REGPLN
rehabilitation	RHBN
relative humidity	RLHDTY
rental housing	RTLHSG
requirements	RQ
research (documentation)	RSDC
research (projects)	RSPRJ
responsibility	RSPN
reviews and summaries (industrialized building)	RVWINBLD
role playing	RLPLY
roofs	RFS
rooms	RMS
rubber	RBR
rural housing	RURHSG
safety	SFTY
salaries	SLRY
sandwich panels, see panel construction systems	
sanitary installations	SNTRYINS
sealants	SLNT
sectional housing	SCTLHSG
self-help building	SLFHPBLD
self-help housing	SLFHPHSG
set theory	STTHRY
settlements	STTLMTS
simulation	SIM
single-story buildings	SGSTYBLD
site design	SITDS
site planning	SITPLNG
site surveys	SITSRV
smoke control	SMKCNT
social aspects	SOCASP
social needs	SOCNDS
social organization	SOCORG
soil-cement	SLCMT
soils	SLS
specialization	SPCZN
specifications	SPCS
stack effect	STKEFF
standardization	STDZN
standards	STDS
statistical decision theory	STATDTH
statistics	STATS
steel construction	STLCNS
steel structures	STLSTRC
streets	STS
structural continuity	STRCNTY
structural engineering	STRENGR
structural frames	STRFR
structures	STRCS
subject indexing	SBINDXG
sulphur	SLPHR
surveys	SRVY
suspended structures	SUSTRC
system analysis	SYSANL
system building	SYSBLD
systems approach	SYSAPPR
systems engineering	SYSENGR
teaching methods	TCHGMTH
technology	TCH
technology (future)	TCHFUT
temperature	TPR
temporary housing	TMPHSG
terminology	TERM
tests	TSTS
thesauri	THSRI
three-dimensional structures	3DSTRC
timber construction	TIMCNS
time-sharing	TMSHRG
tolerances (building)	TOLBLD
topology	TPLGY
trade unions, see unions *(trade and labor)*	
traditional processes	TRDPRCS
transportation	TRNS
two-stage joints	2STGJTS
unions (trade and labor)	UNTR
urban development	URBDV
urbanization	URBTN

urban renewal	URBNRWL
user requirements	USRRQ
utilities (services)	UTLTYSRV
utility core units, see *mechanical systems*	
vacation homes	VCNHOM
value engineering	VLUENGR
variety reduction	VAREDUC
ventilation	VTLN
water	WTR
weather, see climatology	
windows	WDWS
wood (laminated)	WDLM
wood (substance)	WD
work measurement	WKMSMT
work study	WKSTDY
United Kingdom, housing	UKHSG

A list of **Proper Name** Keywords

Abel, Chris	ABELCH
Abrams, Charles	ABRACH
Agabadian, R.	AGABRX
Alexander, Christopher	ALEXCH
Alonso, William	ALONWI
Anderson, Martin	ANDEMA
Anderson, Robert G.	ANDERG
Andrews, Richard B.	ANDRRB
Anthony, Hugh	ANTHHU
Arnold, Christopher	ARNOCH
Arnold, Pauline	ARNOPA
Atkinson, G.	ATKIGX
Aubert, Y.	AUBEYX
Auger, Boyd	AUGEBO
Bair, Frederick H. Jr.	BAIRFH
Balchen, Bess	BALCBE
Barnard, Peter	BARNPE
Bates, Alan	BATEAL
Bazzanella, Liliana	BAZZLI
Bell, S.E.	BELLSE
Bellone, Luigi	BELLLU
Bendixson, Terrence	BENDTE
Bentley, Howard B.	BENTHB
Bergstrom, Lennart Axel	BERGLA
Beyer, H.G.	BEYEHG
Bemis, Albert F.	BEMIAF
Bender, Richard	BENDRI
Birgerson, B.	BIRGBX
Bishop, D.	BISHDX
Blachere, Gerard	BLACGE
Blach, Klaus	BLACKL
Bloom, Benjamin S.	BLOOBS
Bonshor, R.B.	BONSRB
Bowley, Marian	BOWLMA
Boyce, James R.	BOYCJR
Boyer, LeRoy T.	BOYELT
Branchen, Lawsen	BRANLE
Brandle, K. use also Brandle, Kurt	BRANKX
	BRANKU
Brennan, Maribeth	BRENMA
Breuer, Marcel	BREUMA
Brill, Michael	BRILMI
Bromberg, Paul	BROMPA
Bronnihov, P.I.	BRONPI
Brown, Norbert	BROWNO
Bryant, D.S.	BRYADS
Bullivant, Dargan	BULLDA
Burchard III, John	BURCJO
Byrom, J.	BYROJX
Caminos, H.	CAMIHX
Camous, Roger	CAMORO
Campion, David	CAMPDA
Cantelaube, C.	CANTCX
Caplan, Marshall	CAPLMA
Carlsson, P.	CARLPX
Carreiro, Joseph	CARRJO
Carr, Richard	CARRRI
Carson, Eilleen R.	CARSER
Cartmell, G.W.	CARTGW
Catalano, Eduardo	CATAED
Caudill, William	CAUDWI
Chan, W.W.L.	CHANWW
Cherner, Norman	CHERNO
Chipman, Lester	CHIPLE
Chrichton, Charles	CHRICH
Christie, G.A.	CHRIGA
Church, F.L.	CHURFL
Cibula, Evelyn	CIBUEV
Ciribini, G.	CIRIGX
Claxton, Kenneth	CLAXKE
Cleneay, W.A.	CLENWA
Cogswell, Arthur R.	COGSAR
Colean, Miles	COLEMI
Colombi, John S.B.	COLOJS
Cook, John A.	COOKJA
Corker, Eric	CORKER
Cornell, Russell W.	CORNRW
Cousin, Jean	COUSJE
Craig, Sterling	CRAIST
Creighton, Thomas M.	CREITM
Cremese, G.	CREMGX
Csizmadia, Tibor	CSIZTI
Cunin, Hyman	CUNIHY
D'Amelio, Joseph	DAMEJO
Damora, Robert	DAMORO
Danzig, Phillip I.	DANZPI
Davidson, Colin H.	DAVICH
Davidson, J.W.	DAVIJW
Davies, R.M.	DAVIRM
Davis, Tom L.	DAVITL
Davy, Michael C.W.	DAVYMC
Dawson, John A.	DAWSJA
Deeseon, A.F.L.	DEESAF
Delany, D.P.	DELADP
De Reuck, Anthony	DEREAN
DeVos, T.J.	DEVOTJ
Diament, R.M.E.	DIAMRM
Dick, J.B.	DICKJB
Dietz, Albert G.	DIETAG
Dixon, John M.	DIXOJM
Dluhosh, Eric	DLUHER
Donnison, D.V.	DONNDV
Douty, Richard	DOUTRI
Driscoll, S. Porter	DRISSP
Drossel, Margaret R.	DROSMR

Drury, Margaret J.	DRURMJ
Dublin, Martin David	DUBLMD
Dunstone, P.H.	DUNSPH
Durazzo, Ray	DURARA
Dworkin, Phillip	DWORPH
Eaves, Elsie	EAVEEL
Eberhard, John use also	EBERJO
Eberhard, J.P.	EBERJP
Eden, J.F.	EDENJF
Eglit, Victor	EGLIVI
Eichler, Edward P.	EICHEP
Ellwood, Craig	ELLWCR
Emery, F.E.	EMERFE
Engelbrecht, Robert M.	ENGERM
Evans, B.H.	EVANBH
Fakas, Nicholas	FAKANI
Firnkas, Sepp	FIRNSE
Fischer, Robert E.	FISCRE
Fitch, J.M.	FITCJM
Fitzgibbon, James W.	FITZJW
Foster, Charles	FOSTCH
Frampton, Kenneth	FRAMKE
Ferguson, R.S.	FERGRS
Franek, Jiri	FRANJI
Frankl, Lee	FRANLE
Frieden, Bernard J.	FRIEBJ
Fry, E.M.	FRYXEM
Fuller, R. Buckminster	FULLRB
Furman, T.T.	FURMTT
Galbraith John K.	GALBJK
Garden, G.K.	GARDGK
Gauntlett, James	GAUNJA
Garvin, W.L.	GARVWL
Geary, R.	GEARRX
Geddes, Robert L.	GEDDRL
Geyer, Dr. - Ing. Bernard	GEYEBE
Gideon, Sigfried	GIDESI
Gilchrist, Alan	GILCAL
Gill, Paul A.	GILLPA
Gillette, Roy W.	GILLRW
Gloag, John	GLOAJO
Glover, C.W.	GLOVCW

Godfrey Jr., Kneeland	GODFKN
Goel, Surenda K.	GOELSK
Gonzalez-gandolfi, Alberto	GONZAL
Goodovitch, Israel	GOODIS
Gout Jr., Prof. M.	GOUTMX
Graff, R.K.	GRAFRK
Graff, S.	GRAFSX
Grinnel, Peter	GRINPE
Groeger, R.G.	GROERG
Gropius, Walter	GROPWA
Guran, Myron	GURAMY
Guy, R.B.	GUYXRB
use also	GUYRBX
Habraken, N.J.	HABRNJ
Hall, Arthur D.	HALLAD
Halle, Roger	HALLRO
Hallum, R.	HALLRX
Hallum, Vic	HALLVI
Handler, A. Benjamin	HANDAB
Hansen, Edwin L.	HANSEL
Hardless, Trevor	HARDTR
Harries, Michael	HARRMI
Harrison, H. W.	HARRHW
Hastings, Robert F.	HASTRF
Hattis, David B.	HATTDB
Higgin, Gurth	HIGGGU
Hislop, Patrick	HISLPA
Hodgetts, Craig	HODGCR
Hoff, Trygve W.	HOFFTW
Holmes, Brian	HOLMBR
Holton, John K.	HOLTJK
Holzbog, Thomas	HOLZTH
Hooper, William	HOOPWI
Huber, Benedikt	HUBEBE
Hughes, Robert	HUGHRO
Hunt, William Dudley	HUNTWD
Hutcheon, N.B.	HUTCNB
Huxtable, Ada Louise	HUXTAL
Hyde, J.R.	HYDEJR
Jaeggin, K.W.	JAEGKW
Jaquith, Lawrence C.	JAQULC
Jobson, W.J.	JOBSWJ
Johansen, John	JOHAJO

Johnson, R.J.	JOHNRJ
Jones, Rudard A.	JONERA
Kaiser, Edgar	KAISED
Kaiser, Edward J.	KAISEJ
Karlin, Ingvar	KARLIN
Karpati, Klara K.	KARPKK
Kastl, Peter	KASTPE
Katan, Roger	KATARO
Katz, Robert D.	KATZRD
Kelly, Burnham	KELLBU
Kelly, P.M.	KELLPM
Kennedy, Robert Woods	KENNRW
Khazanov, D.	KHAZDX
Kholmyanskii, M.I.	KHOLMI
King, John M.	KINGJM
Kissin, Jean W.	KISSJW
Koch, Carl	KOCHCA
Koehler, Robert E.	KOEHRE
Koenig, Pierre	KOENPI
Komendant, August E.	KOMEAE
Koncz, Dr. - Ing. Tilhamer	KONCTI
Koppes, Wayne F.	KOPPWF
Kruzas, Anthony T.	KRUZAT
Laidlaw, A.	LAIDAX
Landsberg, Hans H.	LANDHH
Laplante, D.G.	LAPLDG
Larson, C. Theodore	LARSCT
Laursen, F. Brink	LAURFB
Lawrence, J.D.	LAWRJD
Leman, B.	LEMABX
Leon, G.	LEONGX
Lessing, Lawrence	LESSLA
Levitt, Abraham D.	LEVIAD
Lewicki, Bohdan	LEWIBO
Lewis, Andy	LEWIAN
Liston, David M.	LISTDM
Liversey, Roger	LIVERO
Llewlyn-Davies, Richard	LLEWRI
Lockwood, A.J.	LOCKAJ
Ludwig, Marilyn	LUDWMA
Lytle, R.J.	LYTLRJ
Macrae, John N.	MACRJN

Madelin, Philippe	MADEPH
Mahaffey, Charles T.	MAHACT
Mainstone, R.J.	MAINRJ
Maisel, Sherman J.	MAISSJ
Malmstrom, P.E.	MALMPE
Manning, Peter	MANNPE
Marchand, P. Eugene	MARCPE
Margolis, Richard	MARGRI
Markus, T.A.	MARKTA
Martin, Bruce	MARTBR
Martin, Paul K.	MARTPK
Masterson, Charles	MASTCH
Matteoli, Lorenzo	MATTLO
McDonough, Adrian M.	MCDOAM
Meier, Hans	MEIEHA
Meyer-Boke, Walter	MEYEWA
Meyerson, Martin	MEYEMA
Michael, Joseph-Marie	MICHJM
Miller, D.S.	MILLDS
Miller, W.C.	MILLWC
Mills, Sonya	MILLSO
Miners, T.W.	MINETW
Minervin, George	MINEGE
Mitchell, Neal	MITCNE
Monk Jr., C.B.	MONKCB
Morgan, William	MORGWI
Morris, P.W.G.	MORRPW
Movshin, Joseph	MOVSJO
Munch-Peterson, J.F.	MUNCJF
Nairn, Peter David	NAIRPD
Napier, Ian A.	NAPIIA
Negroponte, Nicholas	NEGRNI
Nelson, Paul	MELSPA
Nevitt, A.A.	NEVIAA
Nielsen-eltoft, Sigurd	NIELSI
Noble, John	NOBLJO
Nomitch, Roman	NOMIRO
Norair, Henry	NORAHE
O'Brien, T.P.	OBRITP
Oddie, Guy	ODDIGU
O'Grady, John F.	OGRAJF
Ohl, Herbert	OHLXHE
Oliveri, G. Mario	OLIVGM
O'Neill, Richard W.	ONEIRW
Otto, Frei	OTTOFR
Oxley, T.A.	OXLETA
Page, W.D.	PAGEWD
Paine, Donald E.	PAINDE
Paraskevopolous, S.C.A.	PARASC
Parenteau, Henri-Paul	PAREHP
Paris, Jacques	PARIJA
Parker, Dr. T.W.	PARKTW
Parsons, David J.	PARSDJ
Patman, Philip F.	PATMPF
Paulus, Harry J.	PAULHJ
Pawley, Martin	PAWLMA
Pellish, David	PELLDA
Peterson, Charles E.	PETECE
Petro, Sylvester	PETRSY
Pevsner, Nicholas	PEVSNI
Pfrange, Edward O.	PFRAEO
Pierce, John A.	PIERJA
Pinter, George	PINTGE
Platts, R.E.	PLATRE
Plumb, D.S.	PLUMDS
Price, Cedric	PRICCE
Prouve, Jean	PROUJE
Purves, Edmund R.	PURVER
Rabe, George	RABEGE
Rabenek, Andrew	RABEAN
Radigan, F.F.	RADIFF
Redpath, J.I.	REDPJI
Reig, Martin	REIGMA
Robbie, Roderick G.	ROBBRG
use also Robbie R.	ROBBRX
Roberts, C.J.B.	ROBECJ
Roberts, John	ROBEJO
Robison, Rita	ROBIRI
Rock, David	ROCKDA
Rogers, L.C.	ROGELC
Romney, George	ROMNGE
Roos, Daniel	ROOSDA
Rosen, Harold	ROSEHA
use also Rosen, Harold J.	ROSEHJ
Rosenman, D.R.	ROSEDR
Rosenstein, Allen B.	ROSEAB
Ross, Joel E.	ROSSJE
Rothenstein, Guy G.	ROTHGG
Rowland, Norman	ROWLNO
Rozanov, N.	ROZANX
Rudolph, Paul	RUDOPA
Ryd, Mrs. Harriet	RYDXHA
Ryder, J.F.	RYDEJF
Saarinen, Eero	SAAREE
Safdie, Moshe	SAFDMO
Sasaki, J.R.	SASAJR
Scher, Peter	SCHEPE
Schleeh, W.	SCHLWX
Schmid, Thomas	SCHMTH
Schmitz, Gunter	SCHMGU
Schnaidt, Claude	SCHNCL
Severino, Renato	SEVERE
Seymour-Walker, K.J.	SEYMKJ
Shannon, Claude E.	SHANCE
Shapiro, Benjamin	SHAPBE
Sherman, Joseph	SHERJO
Shields, Jane	SHIEJA
Shiffer, Edward T.	SHIFET
Shiffer, Eugene	SHIFEU
Simmonnazi, Marlo	SIMMMA
Simpson, J.W.	SIMPJW
Sittig, J.	SITTJX
Slade, T.M.	SLADTM
Sliwa, Jan	SLIWJA
Smith, D.L.	SMITDL
Smith, Mary L.	SMITML
Smolny, Barbara J.	SMOLBJ
Spillenkothen, Roy	SPILRO
Spindel, Paul D.	SPINPD
Spring, Bernard P.	SPRIBP
Stannett, Annette	STANAN
Stewart, Clifford D.	STEWCD
Stirling, James	STIRJA
Stone, P.A.	STONPA
Stonebraker, Gary	STONGA
Sumichrast, Michael	SUMIMI
Swain, H.T.	SWAIHT
Taylor, H. Ralph	TAYLHR
Taylor, K.G.	TAYLKG

Temko, Allen	TEMKAL
Terner, I.D.	TERNID
Testa, Carlo	TESTCA
Thomsen, Charles B.	THOMCB
Tiers, Charles A.	TIERCA
Tracy, Moira	TRACMO
Trench, Peter	TRENPE
Van der Ryn, Sim	VANDSI
use also Van der Ryn, Sym	VANDSY
Vanettinger, J.	VANEJX
Verges-Escuin, Ricardo	VERGRI
Villeco, Margaret	VILLMA
Volbeda, Ira A.	VOLBIA
Wachsmann, Konrad	WACHKO
Warburton, Ralph	WARBRA
Ward Jr., Robertson	WARDRO
Weaver, *Warren*	WEAVWA
Weiss, Shirley F.	WEISSF
Weissbourd, Bernard	WEISBE
Wells, H. Clarke	WELLHC
Wert, Leonard	WERTLE
Weston, John C.	WESTJC
White, Joseph C.	WHITJC
White, Percival	WHITPE
White, R.B.	WHITRB
Whitmer, Roger	WHITRO
Wilson, R.H.	WILSRH
Winkler, Jack	WINKJA
Wittausch, William K.	WITTWK
Wolff, David S.	WOLFDS
Wood, Kenneth	WOODKE
Wornum, Gray	WORNGR
Worthington, John	WORTJO
Wright, James R.	WRIGJR
Zielinski, Z.A.	ZIELZA
Zollman, Charles	ZOLLCH

A list of **Proper Word** Keywords

Academy Homes, Roxbury, Boston, Mass.	ACHOM
Albert Farewell Bemis Foundation	BMSTFDTN
Aluminum Company of America	ALCOA
American Concrete Institute	ACI
American Institute of Architects	AIA
Arctic Regions	ARCTRGN
Association of Collegiate Schools of Architecture	ACSA
Asia	ASIA
Battelle Memorial Institute	BTTLL
BEAM Program, Department of Industry, Ottawa, Canada	BEAM
Building Industrialization Research and Development Group, Washington University	BIRD
Building Block Modules, Inc.	BLDBLKMD
Building Research Advisory Board	BRAB
Building *Research Institute*	BRI
Building Research Station, Garston, England	BRS
Building Systems Development, Inc.	BSD
Building Systems Information Clearinghouse	BSIC
C.I.B., see International Council for Building Research, Studies and Documentation	
Cornell University	CORNELL
Council of Planning Librarians, Mary Vance, Editor	CPL
Developing Nations	DVNTN
Dow Chemical Company	DOW
Eastern Europe	EAEUR
Edison Electric Institute	EDISON
Educational Facilities Laboratories	EFL
Federal Housing Administration	FHA
Ford Motor Company	FORDMOCO

Geodesic Structures	GDSCSTRC
Geographical Locations, see Arctic Regions, Asia, Developing Nations, Eastern Europe, Scandinavia, Tropical Regions, Union of Soviet Socialist Republics, United Kingdom, United States, Western Europe	
Gunnison Homes	GUNN
Habitat	HBTT
Home Manufacturers Association	HMA
Housing and Home Finance Agency	HHFA
The Housing Institute, Inc.	HSI
Housing Research, Inc.	HSGRSI
Industrialized Building Information System	IBIS
Illinois Institute of Technology	IIT
Illinois Institute of Technology Research Institute	IITRSI
International Congress for Housing and Town Planning	ICHTP
International Council for Building Research, Studies and Documentation (C.I.B.)	CIB
International Federation of Building and Public Works (Paris)	IFBPW
International Labor Office (Geneva)	ILABOFF
International Labor Organization	ILABORG
Kaiser Aluminum and Chemical Corporation	KSRAL
Kaiser Engineers	KSRENG
Levitt & Sons	LVTT
Lustron Corporation	LSTRN

Massachusetts Institute of Technology	MIT
Mitre Corporation	MITRE
Mobile Home Manufacturers Association	MHMA
National Academy of Sciences/ National Research Council	NRC
National Association of Home Builders	NAHB
National Bureau of Standards	NBS
National Homes Corporation	NTLHOM
National Housing Center Library	NHCLIB
New York State Division of Housing and Community Renewal	NYDHCR
Office of Science and Technology	OFFSCTCH
Operation Breakthrough	OPBRKTH
Organization for European Economic Cooperation (Paris)	OEEC
Organization for Social and Technical Innovation, Inc.	OSTI
Pratt Institute	PRATT
The Producers' Council	PC
Scandinavia	SCHNDV
Scholz Homes	SCHLZHOM
School Construction Systems Development	SCSD
Stirling-Homex	STRLGHMX
Study of Educational Facilities	SEF
Techbuilt Homes	TCHBLT
Techcrete	TCHCRT
Tennessee Valley Authority	TVA
Thamesmead	THMSMD
Tropical Regions	TROPREG
Union of Soviet Socialist Republics	USSR
United Kingdom	UK
United Nations	UN
United States	US
United States Advisory Commission on Intergovernmental Relations	USACIR
United States Air Force	USAF
United States Congress, Subcommittee on Urban Affairs	USCNGURB
United States Department of Agriculture	USDA
United States Department of Commerce	USDC
United States Department of Housing and Urban Development	HUD
United States Department of Labor	USDLAB
United States Gypsum Company	USG
United States Library of Congress	USLIBCNG
United States Post Office Department	POD
United States President's Committee on Urban Housing	USURBHSG
University of Illinois Small Homes Council	SHCUI
University of Illinois	UI
University Residential Building Systems	URBS
Vermiculite Institute	VINST
Veteran's Administration	VA
Western Europe	WEUR
Wickes Corporation, The	WICKES

A list of **Periodical** Keywords

Actual Specifying Engineer	ASYE-A
American Builder	ABDR-A
American Building	ABLD-X
American Institute of Architects Journal	AAJO-A
American Institute of Planners' Journal	AIPJ-O
American Society of Civil Engineers, Proceedings, Journal of the Structural Division	JSDE-A
Apartment Construction News	ACNS-X
Appalachia	APLC-A
Appraisal Journal	APPJ-A
Architect and Engineer	ACEG-A
Architects' Journal	ARJO-A
Architectural and Engineering News	AHEN-A
Architectural Design	ACLD-A
Architectural Forum	ACUF-A
Architectural Record	ACUR-A
Architectural Review	ARRV-A
Architecture Canada	ARCA-B
Arts and Architecture	ARAH-A
Art and Industry	ARTI-X
Arts Magazine	ARTM-X
Automation in Housing	AUHG-X
The Builder	BLDR-A
Builders' Journal	BLDJ-X
Building Design and Construction	BDCN-X
Building Materials Merchandiser	BLMM-A
Building Official	BLDO-X
Buildings	BLDG-A
Building Research	BUIR-A
Building Research Station News	BRSN-X
Build International	BLDI-X
Business in Brief	BBRI-A
Business Week	BUWE-A
California Builder	CBLD-X
Canadian Builder	CANB-A
Canadian Building	CANB-X
Canadian Consulting Engineer	CCEG-B
Canadian Forest Industries	CFOI-A
The Carpenter	CARP-X
Chemical and Engineering News	CENE-A
Civil Engineering	CVEG-A
Concrete Construction	CCCN-A
Construction Methods and Equipment	CMEQ-A
Construction Product and Technology	CNPT-X
The Construction Specifier	COSP-A
Constructor	CSTO-A
Contractor News	CTNE-A

Cooperative Housing	COHO-A
Country Life	CYLF-X
Design	DESN-A
Domestic Engineering	DOEN-A
The Economist	ECST-A
Electricity in Building	EBLD-X
Engineering	ENGN-A
Engineering Education	ENED-A
Engineering and Contract Record	ENCR-A
Engineering News Record	ENRE-A
Florida Builder	FLBD-X
Forest Products Journal	FPJO-A
Fortune	FORT-A
Habitat	HABT-A
Habiter	HBTR-X
Home Builder News	HOBN-X
House Beautiful	HBPG-A
House and Garden	HOGA-X
House and Home	HOHO-A
Housing and Planning Review	HPRV-X
Housing and Town and Country Planning	HTCP-X
Industrialization Forum	INFM-X
Industrialized Building Systems and Components	ILCB-A
Interbuilt	INTB-B
International Asbestos-Cement Review	IACV-A
Interiors	ITOR-A
Japan Architect	SKNK-A
Journal of the Federal Home Loan Bank Board	JFHL-X
Loan and Contemporary Problems	LWCP-X
Magazine of Standards	MAST-A
Maryland Home Builder	MDHB-X
Mill and Factory	MFAC-A
Modern Metals	MOML-A
Modern Plastics	MOPL-A
Morgan Guaranty Trust Survey	MGTS-A
The Mortgage Banker	MOBA-A
Municipal and Public Service Journal	MPSJ-A
NAHB Journal of Homebuilding	NHBJ-A
Official Architecture and Planning	OAPA-A
Ontario Housing	ONHO-A
Perspecta	PRPT-X
Plastics Technology	PLTE-A
Plumbing, Heating, Cooling Business	PHCB-B
Plywood and Panel	PLYP-A
Progressive Architecture	PGRA-A
Properties	PROP-X
The Public Interest	PBCI-A
Qualified Contractor	QUCO-A
Canadian Standards Association, Quarterly Bulletin	QBCS-A
Rods Products	ROPR-A
Royal Institute of British Architects' Journal	JRBA-A
Royal Society of Arts Journal	JRSA-A
The Society of Architectural Historians' Journal	SAHJ-A
Stone Magazine	STOM-X
Technology Review	TERE-A
Wood Construction and Building Materialist	WCBM-A

2:433 DEFENSE DOCUMENTATION CENTER

The Defense Documentation Center (DDC) - a field activity of the Defense Supply Agency - makes available from one central depository thousands of research and development reports produced by U.S. military organizations and their contractors. The Center also operates computer-based data banks of management and technical information concerning current R&D projects.

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314
Telephone: (703) 274-7633

Research and Testing Work Unit Information System

The R & T Work Unit Information System (WUIS) is a central information source on current efforts in science and technology. The data bank is a collection of technically orientated summaries describing recent DOD projects. R & T WUIS makes available brief descriptions of R & T efforts currently in progress.

Defense Documentation Center - Report Bibliography

The Report Bibliography responds to specific requests for technical information. Literature searches can be made in various ways, including subject matter, document sources, contract or project numbers, or personal authors. The resulting bibliography has each page containing a separate report.

It is also possible to request Rapid Response Bibliographies from DDC, but communication is by Telex telecommunication equipment. DDC provides listings of *accession document (AD) numbers* of reports which are pertinent to the information request. The response time within DDC should be only 24 hours, and with the elimination of postal time, this service provides quick access to information.

Independent Research and Development Information System

Independent R & D is that work performed by non-government organizations, not on contract, having to do with advanced technology, systems, or hardware. This data bank enables DOD scientist and engineers to identify independent industrial organizations and their technical work.

Research and Development Program Planning Information

This is a central repository of program planning documents needed in reviewing and approving DOD R & D programs. The R & DPP Information System is comprised of planned R & D efforts on the project and task area levels. These efforts are categorized into four major areas: (1) Research; (2) Exploratory Development; (3) Advanced Development, Engineering Development, and Operational System Development; and (4) Management and Support. Individual DOD activities may utilize the system to identify planned RPT&E programs in certain scientific or technical areas for a specific budget year.

2:434 SMITHSONIAN SCIENCE INFORMATION EXCHANGE

This exchange - an activity of the Smithsonian Institute - makes available research information on many aspects of science and engineering.

Smithsonian Science Information Exchange
1730 M Street, N.W.
Washington, D.C. 20036
Telephone: (202) 381-5511

In response to a specific request, SSIE will search its files for pertinent research projects. Requests may be by subject or by administration, *i.e.*, countries, states or educational institutions. Results from a search include a summary of pertinent projects. The fee is $50.00 per search (up to 100 ducuments) plus $15.00 for each additional 100 documents or fraction thereof.

2:435 NATIONAL TECHNICAL INFORMATION SERVICE

This agency of the Department of Commerce is a central source for the public sale of government-sponsored research, development and engineering reports. It is also a central source for federally-generated, machine-processed data files and programs.

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22151
Telephone: (703) 321-8500

NTI Search

NTIS offers a customized bibliography service. In response to a specific request, NTIS will search its files (1964 to date) for pertinent technical reports. The resultant bibliography is a collection of 4" x 6" cards, each containing a reference to a report and an abstract. The charge for a NTI search is $50.00 for up to 100 abstracts, and $.25 for each additional abstract. A search request can be made by telephone, (703) 451-0560.

2:436 WEEKLY GOVERNMENT ABSTRACTS

These weekly reports cover testing of materials and processes, new techniques and ways to improve products, and modifications of materials and processes. The publications cited are those of government agencies and private organizations on federal contract. The following twelve *titles are available for annual subscription.*

Administration	$17.50
Behavior	35.00
Biomedical Technology and Engineering	28.00
Building Technology	17.50
Business and Economics	28.00
Computers, Control and Information Theory	22.50
Environmental Pollution and Control	22.50
Industrial Engineering	35.00
Literary and Information Sciences	20.00
Materials Sciences	22.50
Transportation	17.50
Urban Technology	35.00

SECTION FOUR

A LIST OF USEFUL ADDRESSES

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2:441 STATE AND NATIONAL

Assistant Administrator for Construction (08)
Veterans Administration
810 Vermont Avenue, N.W.
Washington, DC 20420

Commanding Officer
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120

Construction Section
Department of Housing and Urban Development
Federal Housing Administration
451 7th Street, S.W.
Washington, DC 20410

Division of Forest Products & Engineering Research (FPER, USDA-FS)
USDA Forest Service
South Building
12th & Independence Avenue, S.W.
Washington, DC 20250

Engineering Standards Service (NBS)
National Bureau of Standards
Washington, DC 20234

U. S. Department of Commerce
National Bureau of Standards
Center for Building Technology
Washington, DC 20234

Factory Mutual Engineering Corp. (FMED)
Standards-Laboratories Department
1151 Boston-Providence Turnpike
Norwood, MA 02062

Forest Products Laboratory (USFPL)
Forest Service
United States Department of Agriculture
P. O. Box 5130
Madison, WI 53705

IIT Research Institute (IITRI)
(formerly Armour Research Foundation of Illinois Institute of Technology)
10 West 35th Street
Chicago, IL 60616

NAHB Research Foundation, Inc. (NAHB)
Research Laboratory
Rockville, MD 20850

National Fire Protection Association (NFPA)
60 Batterymarch Street
Boston, MA 02110

National Sanitation Foundation Testing Laboratory, Inc. (NSFTL)
P. O. Box 1468
Ann Arbor, MI 48106

The Ohio State University (OSU)
Building Research Laboratory
2070 Neil Avenue
Columbus, OH 43210

The Pennsylvania State University (PSU)
Research Institute
University Park, PA 16802

Pittsburgh Testing Laboratory (PTL)
850 Poplar Street
Pittsburgh, PA 15220

U. S. Department of Commerce
National Bureau of Standards
Washington, DC 20234

2:442 CODE ORGANIZATIONS AND STANDARDS GROUPS

American Insurance Association (AIA)
Engineering and Safety Services
85 John Street
New York, NY 10038

American National Standards Institute Inc. (ANSI)
(formerly United States of America Standards Association, Inc.)
(formerly American Standards Institute)
1430 Broadway
New York, NY 10018

Associated General Contractors of America (AGC)
1957 E Street N.W.
Washington, DC 20006

BRAB Building Research Institute (BRI)
National Research Council
2101 Constitution Avenue
Washington, DC 20418

Building Fires and Safety Section
Center for Building Technology
National Bureau of Standards
Washington, DC 20234

Building Officials and Code Administrators International (BOCA International)
1313 East 60th Street
Chicago, IL 60637

International Conference of Building Officials (ICBO)
50 South Los Robles
Pasadena, CA 91101

National Association of Home Builders (NAHB)
1625 L Street N.W.
Washington, DC 20036

National Fire Protection Association (NFPA)
60 Batterymarch Street
Boston, MA 02110

National Safety Council (NSC)
425 North Michigan Avenue
Chicago, IL 60611

Southern Building Code Congress (SBCC)
750 Brown-Marx Building
Birmingham, AL 35203

Underwriters' Laboratories, Inc. (ULI)
207 East Ohio Street
Chicago, IL 60611

Underwriters' Laboratories, Inc. (ULI)
333 Pfingsten Road
Northbrook, IL 60062

2:443 PROFESSIONAL SOCIETIES

American Institute of Architects (AIA)
1735 New York Avenue, N.W.
Washington, DC 20006

American Institute of Planners (AIP)
1776 Massachusetts Avenue N.W.
Washington, DC 20036

American Society of Civil Engineers (ASCE)
United Engineering Center
345 East 47th Street
New York, NY 10017

American Society of Mechanical Engineers (ASME)
United Engineering Center
345 East 47th Street
New York, NY 10017

American Society of Sanitary Engineering (ASSE)
960 Illuminating Building
Cleveland, OH 44113

American Water Works Association (AWWA)
2 Park Avenue
New York, NY 10016

Consulting Engineers Council of the U.S. (CEC)
1155 15th Avenue N.W.
Washington, DC 20005

Masterspec
American Institute of Architects
1735 New York Avenue, N.W.
Washington, DC 20006

National Association of Housing and Redevelopment Officials (NAHRO)
2600 Virginia Avenue, Suite 404
Washington, DC 20037

National Society of Professional Engineers (NSPE)
2029 K Street, N.W.
Washington, DC 20006

2:44 GENERAL STANDARDS AND TESTING LABORATORIES

American Insurance Association (AIA)
Engineering & Safety Service
85 John Street
New York, NY 10038

American National Standards Institute, Inc. (ANSI)
(formerly United States of America Standards Institute, Inc.)
(formerly American Standards Association)
1430 Broadway
New York, NY 10018

American Society for Testing & Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103

BRAB Building Research Institute (BRI)
2101 Constitution Avenue
Washington, DC 20418

The Detroit Testing Laboratory, Inc. (DTL)
8720 Northend Avenue
Detroit, MI 48237

Underwriters' Laboratories, Inc. (ULI)
207 East Ohio Street
Chicago, IL 60611

2:445 GENERAL TRADE ASSOCIATIONS

American Carpet Institute Inc.
350 Fifth Avenue
New York, NY 10001

American Association of Nurserymen, Inc. (AAN)
Suite 835, Southern Building
Washington, DC 20005

The Asphalt Institute
Asphalt Institute Building
College Park, MD 20740

Asphalt Roofing Manufacturers' Association (ARMA)
757 Third Avenue
New York, NY 10017

Expanded Shale, Clay and Slate Institute
1041 National Press Building
Washington, DC 20004

Flat Glass Marketing Association
1325 Topeka Avenue
Topeka, KS 66612

Lightweight Aggregate Producers Assn.
546 Hamilton Street
Allentown, PA 18105

Mason Contractors Assn. of America
208 South LaSalle Street
Chicago, IL 60604

Mechanical Contractors' Association (MCA) of America Inc.
Suite 750
5530 Wisconsin Avenue
Washington, DC 20015

National Association of Home Builders (NAHB)
National Housing Center
1625 L Street, N.W.
Washington, DC 20036

National Association of Plumbing-Heating-Cooling Contractors (NAPHCC)
1016 20th Street, N.W.
Washington, DC 20036

National Clay Pipe Institute (NCPI)
1130 17th Street, N.W.
Washington, DC

National Paint, Varnish and Lacquer Association
1500 Rhode Island Avenue, N.W.
Washington, DC 20005

Painting and Decorating Contractors of America
7233 Lee Highway
Falls Church, VA

Water Conditioning Foundation
1780 Maple
P. O. Box 194
Northfield, IL 60093

2:446 FIRE TESTING LABORATORIES

The Ohio State University (OSU)
Building Research Laboratory
2070 Neil Avenue
Columbus, OH 43210

Southwest Research Institute (SWRI)
8500 Culebra Road
San Antonio, TX 78228

Underwriters' Laboratories, Inc. (ULI)
207 East Ohio Street
Chicago, IL 60611

Underwriter's Laboratories, Inc. (ULI)
333 Pfingsten Road
Northbrook, IL 60062

Underwriters' Laboratories, Inc. (ULI)
1655 Scott Boulevard
Santa Clara, CA 95050

AUTHORITATIVE TRADE STANDARDS

Concrete

American Concrete Institute (ACI)
P. O. Box 4754 Redford Station
22400 West Seven Mile Road
Detroit, MI 48219

Concrete Reinforcing Steel Institute (CRSI)
228 North LaSalle Street
Chicago, IL 60601

Gypsum Association (GA)
201 North Wells Street
Chicago, IL 60606

National Lime Association (NLA)
501 Wisconsin Avenue, N.W.
Washington, DC 20016

Portland Cement Association (PCA)
5420 Old Orchard Road
Skokie, IL 60076

Electrical

Illuminating Engineering Society (IES)
345 East 47th Street
New York, NY 10017

International Association of Electrical Inspectors (IAEI)
201 East Erie Street
Chicago, IL 60611

National Electrical Manufacturers' Assn. (NEMA)
155 East 44th Street
New York, NY 10017

Underwriters' Laboratories, Inc. (ULI)
207 East Ohio Street
Chicago, IL 60611

Equipment and Environmental Control

Air-Conditioning and Refrigeration Institute (ARI)
1815 North Fort Myer Drive
Arlington, VA 22209

American Gas Association (AGA)
8501 East Pleasant Valley Road
Cleveland, OH 44131

American Petroleum Institute (API)
1801 K Street, N.W.
Washington, DC 20006

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
United Engineering Center
345 East 47th Street
New York, NY 10017

The American Society of Mechanical Engineers (ASME)
United Engineering Center
345 East 47th Street
New York, NY 10017

The Hydronics Institute
35 Russo Place
Berkeley Heights, NJ 07922

Incinerator Institute of America (IIA)
2425 Wilson Boulevard
Arlington, VA 22201

International Association of Plumbing & Mechanical Officials (IAMPO)
5032 Alhambra Avenue
Los Angeles, CA 90032

National Automatic Sprinkler and Fire Control Association, Inc. (NASFCA)
2 Holland Avenue
White Plains, NY 10603

National Elevator Industry, Inc. (NEII)
600 Third Avenue
New York, NY 10016

National Environmental Systems Contractors Assocation (NESCA)
Suite 110,
1501 Wilson Boulevard
Arlington, VA 22209

National LP-Gas Association (NLPGA)
79 West Monroe Street
Chicago, IL 60603

National Oil Fuel Institute, Inc. (NOFI)
60 East 42nd Street
New York, NY 10017

Uniform Boiler and Pressure Vessel Laws Society, Inc. (UBPVLS)
57 Pratt Street
Hartford, CT 06103

Interior Finishes and Masonry

Acoustical and Insulating Materials Assn. (AIMA)
205 West Touhy Avenue
Park Ridge, IL 60068

American Hardboard Association (AHA)
20 North Wacker Drive
Chicago, IL 60606

Brick Institute of America
1750 Old Meadow Road
McLean, VA 22101

Facing Tile Institute (FTI)
111 East Wacker Drive
Chicago, IL 60606

Gypsum Association (GA)
201 North Wells Street
Chicago, IL 60606

Indiana Limestone Institute of America, Inc. (ILIA)
Stone City Bank Building
Suite 400
Bedford, IN 47421

International Masonry Institute
823 Fifteenth Street, N.W.
Washington, DC 20005

Marble Institute of America Inc. (MIA)
1984 Chain Building Road
McLean, VA 22101

National Building Granite Quarries Assn., Inc. (NBGQA)
North State Street
Concord, NH 03302

National Concrete Masonry Association (NCMA)
P. O. Box 9185, Rosslyn Station
1800 North Kent Street
Arlington, VA 22209

National Lime Association (NLA)
5010 Wisconsin Avenue N.W.
Washington, DC 20016

National Terrazzo & Mozaic Association
716 Church Street
Alexandria, VA 22314

Perlite Institute, Inc. (PI)
45 West 45th Street
New York, NY 10036

Portland Cement Association (PCA)
5420 Old Orchard Road
Skokie, IL 60076

Resilient Tile Institute (RTI)
101 Park Avenue
New York, NY 10017

The Society of the Plastics Industry, Inc. (SPI)
250 Park Avenue
New York, NY 10017

Structural Clay Products Institute (SCPI)
1750 Old Meadow Road
McLean, VA 22101

Tile Council of America (TCA)
Research Center—P. O. Box 326
Princeton, NJ 08540

Metal and Steel

Aluminum Association (AA)
750 Third Avenue
New York, NY 10017

American Institute of Steel Construction, Inc. (AISC)
101 Park Avenue
New York, NY 10017

American Iron and Steel Institute (AISI)
150 East 42nd Street
New York, NY 10017

American Zinc Institute, Inc.
292 Madison Avenue
New York, NY 10017

Cast Iron Soil Pipe Institute (CISPI)
2029 K Street, N.W.
Washington, DC 20006

Concrete Reinforcing Steel Institute (CRSI)
228 North LaSalle Street
Chicago, IL 60601

Copper Development Association, Inc. (CDA)
405 Lexington Avenue
New York, NY 10017

Lead Industries Association, Inc. (LIA)
292 Madison Avenue
New York, NY 10017

Metal Building Manufacturers Association (MBMA)
2130 Keith Building
Cleveland, OH 44115

Research Council on Riveted and Bolted Structural Joints (RCRBSJ)
United Engineering Center
345 East 47th Street
New York, NY 10017

Scaffolding & Shoring Institute (SWI)
2130 Keith Building
Cleveland, OH 44115

Steel Deck Institute (SDI)
9836 West Roosevelt Road
Westchester, IL 60153

Steel Door Institute (SDI)
2130 Keith Building
Cleveland, OH 44115

Steel Joist Institute (SJI)
2001 Jefferson Davis Highway
Arlington, VA 22202

The Steel Window Institute (SWI)
2130 Keith Building
Cleveland, OH 44115

Truss Plate Institute, Inc. (TPI)
Suite 205
919 Eighteenth Street, N.W.
Washington, DC 20006

Wire Reinforcement Institute
7900 Westpark Drive
McLean, VA 22101

Wood and Wood Products

Acoustical and Insulating Materials Assn. (AIMA)
205 West Touhy Avenue
Park Ridge, IL 60068

American Hardboard Association (AHA)
20 North Wacker Drive
Chicago, IL 60606

American Institute of Timber Construction (AITC)
333 West Hampden Avenue
Englewood, CA 80110

American Plywood Association (APA-DFPA)
1119 A Street
Tacoma, WA 98401

American Walnut Association
Room 1730, 666 Lakeshore Drive
Chicago, IL 60611

American Wood Preservers Association (AWPA)
1625 Eye Street, N.W.
Washington, DC 20006

American Wood Preservers Institute (AWPI)
1651 Old Meadow Road
McLean, VA 22101

Appalachian Hardwood Manufacturers, Inc. (AHM)
1015 Mercantile Library Building
414 Walnut Street
Cincinnati, OH 45202

Arkansas Soft Pine Bureau
1660 Union National Plaza
Little Rock, AR 72201

Association of Timber and Timber Treatment Inspection Agencies (ATTTIA)
729 Fisher Road
Grosse Pointe, MI 48230

California Redwood Associationa (CRA)
617 Montgomery Street
San Francisco, CA 94111

Douglas Fir Plywood Association
1119 A Street
Tacoma, WA 98402

Fine Hardwoods Association
Room 1730, 666 North Lake Shore Drive
Chicago, IL 60611

Fir & Hemlock Door Association (FHDA)
1500 Yeon Building
Portland, OR 97204

Hardwood Plywood Manufacturers Association (HPMA)
P. O. Box 6246
Arlington, VA 22206

Insulating Siding Association
1201 Waukegan Road
Glenview, IL 60025

National Forest Products Association, Inc. (NFOPA)
1619 Massachusetts Avenue, N.W.
Washington, DC 20036

National Hardwood Lumber Association
59 East Van Buren Street
Chicago, IL 60605

National Lumber and Building Material Dealers Association (NLBMDA)
Suite 350, 1990 M Street, N.W.
Washington, DC 20036

National Oak Flooring Manufacturers' Association
814 Sterick Building
Memphis, TN 38103

Northern Hardwood and Pine Manufacturers' Association (NHPMA)
501 Northern Building
Green Bay, WI

Ponderosa Pine Woodwork Assn. (PPW)
1500 Yeon Building
Portland, OR 97204

Product Fabrication Service (PFS)
P. O. Box 5038
Madison, WI 53705

Red Cedar Shingle and Handsplit Shake Bureau (RCSHSB)
5510 White Building
Seattle, WA 98101

Southern Cypress Manufacturers Assn.
1614 Berwick Road
Jacksonville, FL 32207

Southern Forest Products Association (SFPA)
P. O. Box 52468
New Orleans, LA 70150

Southern Hardwood Lumber Manufacturers Assn.
(SHLMA)
805 Sterick Building
Memphis, TN 38103

Southern Pine Inspection Bureau
P. O. Box 846
Pensacola, FL 32594

Timber Engineering Company (TECO)
5530 Wisconsin Avenue
Washington, DC 20015

West Coast Lumber Inspection Bureau
6980 S.W. Varnes Road
P. O. Box 23145
Tigard, OR 97223

Western Red Cedar Lumber Association
(WRCLA)
1500 Yeon Building
Portland, OR 97204

Western Red & Northern White Cedar Assn.
1017 Plymouth Building
Minneapolis, MN 55403

Western Wood Products Association (WWPA)
1500 Yeon Building
Portland, OR 97204

chapter five

EXPLANATION OF TERMS

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SECTION ONE

GLOSSARY OF TERMS

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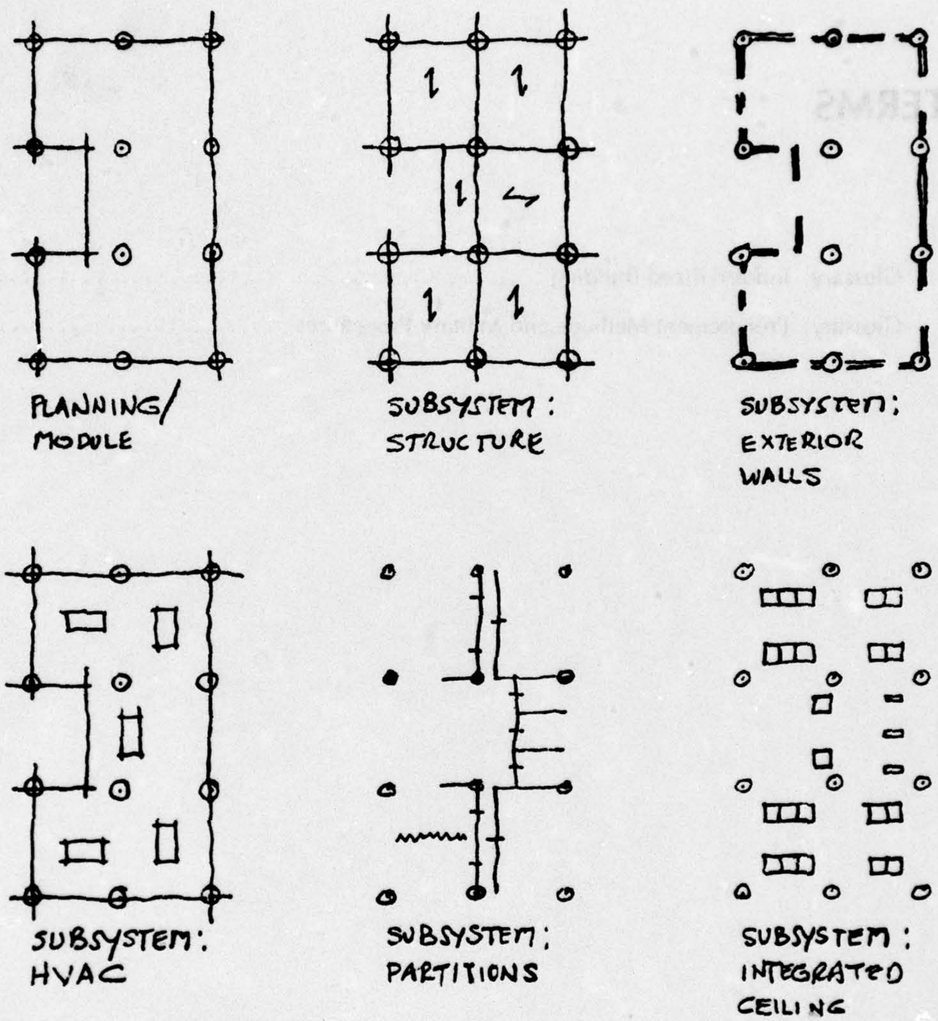

(Sketch by Jack Lee, TEC)

2:510 DEFINITIONS

Aggregation: The treatment of a group of similar building projects (possibly at several installations, or to be built in several different years) as a single project.

Attribute: An inherent characteristic or quality.

Basic Module: A module with the size of 4 inches or 100 milimeters used to coordinate the dimensions of components.

Bidder: An offerer or proposer in two-step bidding whose proposals has been found acceptable and who is being invited to bid.

Boiler Plate: The "front-end" documents in a specification pertaining to legal aspects of the contract as well as contract administration, *i.e.*, standard legal clauses to create a valid contract and express mandatory and optional clauses which must/should be in the contract.

Box: A term sometimes used for prefabricated three-dimensional system of floor, walls, and ceiling—usually closed-system, used primarily in housing.

Building Code: The collection of regulations applicable to current building activities in a particular location.

Building Standard: An approved criterion governing the quality of a defining construction material, operation, functional requirement, or method of assembly.

Building System: An arrangement which permits many detailed decisions about a method of construction to be determined for a range of building situations in advance of any particular building project. (See also *System*)

Building Subsystem: A pre-designed, functionally integrated series of parts which function as a unit within prescribed performance characteristics.

Building Type: A classification according to principal activities or uses for which it was constructed.

Bulk Purchase: (See *Mass Purchase*)

Closed System: A building system - normally proprietary - of such a unique design, or so controlled by the supplier, that parts outside the system can be substituted only with substantial modification or not at all. (See *Open Building System*).

Compatible (Building System): Two or more building subsystems whose every point of functional and physical interface matches and is congruous. (See *Interface* and *Component Compatibility*)

Component: An industrial product, as an independent unit for installation or an essential element of a building subsystem. Factory-finished product designed to be part of the compelte building or system without modification on site.

Components, general multi-purpose: Products of general utility which are not limited in use to one building element. (e.g., sheets, boards, blocks, wires).

Components, particular single purpose: Products for a particular application manufactured to form one specific building element. (e.g., doors, windows, locks, bolts, etc.)

Component Compatibility: Properties of components that guarantee that they can easily be joined to other components without requiring special decisions or physical modifications.

Constant Dollar: A monetary base to which fluctuations in value are adjusted.

Construction Management: The combined operations for the authorization, purchasing, supervision, accomplishment, and acceptance of a construction project. These activities do not normally include economic feasibility studies, programming/planning, or industrial management, which would be a part of many IBS projects. The coordination of multi-contract projects may be required.

Construction Manager: A professional, usually retained as an owner's agent, who performs construction management.

Contracting Officer: A military officer or Corps employee authorized to administer contracts and make determinations and findings thereto.

Controlling Dimensions: A dimension which indirectly limits the size of components, e.g., floor-to-floor height, as a controlling dimension in sizing floor-to-ceiling partitions.

Conventional Construction: Site-coordinated construction, utilizing a combination of field-crafted and factory-fabricated components which are not generally precoordinated. These components therefore often require modification at the building site to provide workable joining conditions.

Counsel: The legal representative of a contracting officer.

Criterion: A standard rule or test by which performance or a characteristic is measured and a judgement formed. Plural: criteria.

Determinant: (See *Performance Requirement*)

Development: The effort required to produce new products or to significantly modify existing ones in response to performance standards.

Dimensional Coordination: The establishment of a range of related dimensions for common use in sizing the components which make up those buildings.

District Engineer: The officer in a Corps district responsible for supervising and administering civil and military construction assigned to his district.

Evaluation: Evaluation consists in bringing together two things: 1) an object to be evaluated, and 2) a judgement providing a framework in terms of which an evaluation can be made. The bringing together of these two is mediated by 3) a criterion of evaluation that embodies given standards. Evaluation in effect can be viewed as a mode of classification. The evaluation is limited to the condition of use envisaged at the time. Evaluation can only relate to the use in the manner stated or implied.

Fast Track: A scheduling technique involving overlapping (or simultaneous), phased design and construction (as opposed to sequential operations) to speed the building process, and often requiring multiple contracts.

Feedback: The returning of information about the results of decisions to the originator of those decisions; Output or information so returned. Also, in systems analysis: That part of the systems output which, in a modified or raw form, is used to control system performance by introducing it in combination with the input. For stable systems, feedback is nil.

Fixed Design Strategy: An administrative strategy in which proposers must respond to and work within fixed *conceptual* building and site plans. Probably a single contract, this permits the use of flexible interfacing subsystems.

Footprint: A space defined on a plot plan within which proposed building construction must be confined.

Footprint Strategy: An administrative strategy in which the building is proposer-designed within an area (the "footprint") defined in RFP/FRTP plats; this requires the postponement of the design of that portion of the site within the footprint and its submission with the proposal, though the main portion of the site is prescriptively defined. Probably a single contract, this approach defines functional relationships and area requirements while allowing unique systems response.

Functional Co-ordination: The organizing of performance characteristics to enable optimum performance to be obtained from combinations of building subsystems and components.

Functional Requirements: Expressions of the functions required of an object, in qualitative terms.

Functional Test: A test performed to demonstrate that an article or appliance operates as required.

Hardware: The components, assemblies, and subsystems of which a building is constructed.

Industrialized: Organized to convert raw materials into products by capital-intensive activities, such as mechanization and automation, as opposed to labor-intensive activities, such as organized handcraft.

Industrialized Building: The process of construction involving capital-intensive processes such as mechanization and automation, as opposed to organized handcraft, a labor-intensive activity. Industrialization *may* apply to a part of a construction or delivery process, as with production, delivery, and erection of components. In addition to building products, industrialization may apply to process-oriented activities as automated information transfer.

Industrialized Building System: (See *Industrialized Building* and *Systems*)

***In-Process* Inspection:** Inspection which is performed during the manufacturing phase in an effort to prevent nonconformances from occuring, to determine conformance with drawings and specifications, and to inspect the characteristics and attributes which are not capable of being inspected and/or corrected at final inspection.

In Situ (Construction): Assembled in the final intended position on or in a building.

Inspection: The process of measuring, examining, testing, or otherwise comparing the article or service with specified requirements.

Installation (Building): Placing and fixing of prefabricated non-structural elements.

Interchangeability: Part of the technique of mass-production, which is the ability to control the dimensions of components so that they can be assembled without selection and without any attention to matching surfaces, such as cutting, fitting, and abutting.

Interface: A common boundary or dimensional fit between components. The act or process of assuring a positive and functional fit at that common boundary. The point of contact of construction activities.

Joint Interface: The meeting place of a jointing product and/or a building component.

Lead Time: That length of time preceding an event required for its implementing activities.

Life Cycle Costing: A method of economic building analysis which considers costs - such as maintenance, insurance, operation (including energy), repair, and replacement which will likely be incurred throughout the life of the building, as well as initial construction costs.

Manufacturing Dimensions: The dimensions specified for the manufacture of a component.

Manufacturing Tolerance: An allowance for the lack of accuracy permitted for the production of a component.

Mass Production: A mechanical engineering technique for making large numbers of similar components or assemblies.

Mass Purchase: An arrangement for bulk buying (sometimes stockpiling, sometimes contracting for supplying over a period of time) of products or materials, usually from a single supplier, to reduce unit cost or to guard against possible depletion.

Mobile Home: A factory-built, self-contained home on a chassis for transport to the site. Commonly sold through dealers, often treated as personal property for taxing and legal purposes; used with or without a permanent foundation as a dwelling unit when connected to utilities.

Mock-up: A scale model or full-scale replica of a structure or apparatus, used for study, testing, or display.

Modular: A unit measurement grid to which all proportions of a dimensional coordination system are related; constructed with standardized units whose sizes conform to a three-dimensional grid; integrals or multiples of a standard dimension; a term sometimes applied to a "box" system, joined with other units to form permanent housing.

Modular Coordination (In Construction): The use of dimensioned elements which, based on a

module, allow them to be finally positioned within a construction complex without undergoing modification.

Module: A unit of measurement to which all dimensions forming part of a modular coordination system are referred. Often set by a subsystem component, module multiples logically determine room and building dimensions.

Module (Modular Building): A factory assembled, three-dimensional section of a building designed to be shipped to site and joined with one or more sections to form a building to meet the same construction, health, and safety requirements as for conventional on-site building.

Modular Building (or House): A permanent structure consisting of one or more modules assembled in a factory in accordance with a building code, and qualified to be financed and taxed as real property when placed upon a permanent foundation.

Non-System (Building Components & Assemblies): All *conventional* portions of a building, e.g., that which is handcrafted or conventionally constructed.

Offeror: A proposer responding to an RFTP in two-step procurement. The term is used only in connection with Step 1; in Step II the offeror becomes the bidder.

Off-the-Shelf: Available as a marketed stock product.

Off Site: Remote from the building site, not within the contract limit line.

One-Off (Building): Construction of a unique building or group of buildings, not planned for duplication.

One-Step Procurement: A procurement option in which competing technical proposals, together with dollar bids, are evaluated according to a predetermined scoring scheme, the contract being awarded to the proposal having the highest score, not necessarily the lowest bid.

On Site: Within the confines of the building site but not necessarily within the building (see *In Situ*).

Open System: A building system whose subsystems or components are compatible with other subsystems or components, including those of other manufacturers, for interchangeability. Also, a catalog of parts—factory-finished, standard components of varied origin—selected by independent designers and assembled in an infinite number of ways. Wide variety.

Out-of-System: (See *Non-System*)

Package Deals: In the general category of "Package Deals" are several forms of contracting in which the contractor executes both the design and construction work.

Package Strategy: An administrative strategy which requires the proposer to design and supply both building and site work to specification. A single contract, this provides less overall control by the owner over esthetics and functional relationships. It features a pre-designed, closed system product, supplied and erected by a single contractor.

Package Housing: Factory assembled into units such as walls, roof trusses, interior partitions, windows, doors, and cabinets, arranged in shipment to facilitate site construction sequences; they sometimes include a mechanical core.

Panel: A prefabricated planar product, often story-height or room-width, sometimes loadbearing, and sometimes containing integrated utilities.

Performance Assessment: Interpretation of data (measured, calculated, estimated) to assess whether the object answers the general rules of quality.

Performance Attributes: Physical properties of an object, expressed in view of the expected result (in direct relation to its behavior).

Performance Characteristics: Description of a product in terms of its performance.

Performance Concept: An organized procedure or framework within which it is possible to state the desired attributes of a material, component, or system in order to fulfill the requirements of the user without regard to the specific means to be employed in achieving the results.

Performance Criteria: A set of statements of the essential characteristics that a component must provide in order to fulfill (a) user needs and/or (b) its role in a building sub-system. Also, standard rules or tests in terms of desired behavior or results (rather than in terms of materials or products and the way they should be combined), by which performance is measured and judgement formed. These provide maximum bidding freedom for material selection and for fabrication and installation methods. (See *Criterion*).

Performance Declaration: A statement by the manufacturer that a product has certain performance characteristics.

Performance Requirement: Expressions of the functions required of an object, in quantitative imperative terms.

Performance Specification: Expression of the functions required of an object, corresponding to clearly determined use. A written description of requirements and criteria in terms of a product or a system's desired behavior (rather than in terms of its makeup and the way it should be constructed), e.g., not what a system *is*, but what it *does*. (See *Prescriptive Specifications*)

Performance Test: Test of a product in conditions which simulate the conditions of its use, in order to measure its total performance.

Planning Grid: A graphic framework, usually rectangular, for organizing a building's horizontal dimensions, sometimes based on the size of a manufactured module.

Pre-cut: Factory cut and labeled materials, with little assembly work.

Pre-engineered: A building satisfying a standard set of engineering requirements rather than user requirements; often a gable-roofed clear span, metal building, available "off-the-shelf."

Prefabrication: The fabrication of building elements before they reach the building site.

Prescriptive Specification: A precise, written description of requirements for construction, indicating materials, shapes, sizes, and methods used to establish standards and to provide a product. (See *Performance Specification*)

Prescriptive Statement: A set of prescriptive statements define the required product, system, service, or design configuration without reference to the end result or use. They may be defined with words, as in specifications, or illustrations, as in plans.

Printout: Data output from a computer.

Process: A series of operations directed toward achieving an end.

(Building Delivery) Process: A series of operations directed toward the realization of a building, starting with identification of the need for a building and ending with its occupancy.

Procurement Option: One of several means of contracting for building(s) and grounds.

Project: A collection of one or more buildings under construction, along with necessary support facilities (*i.e.*, paving, utility lines). Since the feasibility of IBS may be a function of the number of structures involved, as well as their locations, it may be necessary to aggregate buildings of the same type into different groupings, herein called "projects"; a line item in a military budget, designated for construction in a fiscal year.

Project Management: The planning and control of an operation to achieve the objective of taking a project from state "a" to state "b." The project may be of any scale and the end points "a" and "b" may specify any range.

The management of a project from inception through design to the completion of construction by any method or methods acceptable to the owner.

Project Manager: A professional, usually retained as an owner's agent, to coordinate a project from inception to completion, including such activities as feasibility studies, programming, designing, scheduling, fiscal control, and construction; In the Corps, that officer responsible for administering a project, exercising full line authority over planning, research, development, procurement, production, distribution, and logistics.

Proposer: Any individual, firm, contractor, or building manufacturer that responds to a request for proposals on a building project.

Proprietary Product: Produced by one manufacturer for one sponsor only, to his own standards. Made and marketed by one having the exclusive right to manufacture and sell; sometimes involving guarded information.

Quality Assurance: A planned and systematic pattern of all actions necessary to provide adequate confidence that an article will meet all specified requirements.

Quality Assurance Standard: A statement, usually documented, which defines the criteria for acceptance and/or rejection of a service, process, or product.

Quality Control: A management function whereby control of quality of raw or produced material is exercised for the purpose of preventing the production of defective items.

Reclama: A resubmittal, request for reconsideration, or challenge submitted by DOA to DOD, to a denial of a proposed project or Program budget decision.

Request for Technical Proposal: A solicitation for proposals containing design and technical criteria plus administrative and legal provisions.

Sequential Strategy: An administrative strategy used in this guide, which requires the proposer to design and supply buildings to specification, both prescriptive and performance. Buildings are located on-site and site design is finalized by the owner after the system is chosen. Probably dual contract, though special single-contract provisions can provide for site contingencies.

Site: A plot of ground for, or with, a building.

Site Assembly: Application of a system of building on the site, including the making of certain functional elements.

Site Construction: Excavation and earth work, drainage, piling, fencing, etc.

Software: The rules and procedures for utilizing hardware to form a completed building; e.g., a program or design; the non-physical elements of a system.

Source Inspection: Inspection at the facility of the subcontractor or supplier of articles or materials to be incorporated into the housing system.

Spaceframe: A three-dimensional truss, sometimes curved.

Strategy: The method of communicating the Government's requirements for a facility to potential proposers or bidders. Design strategies differ in the degree of detail which is completed by the Government or left to the proposers. (See *Fixed Design Strategy, Footprint, Package,* and *Sequential*).

Subsystem: Part of a building system performing a specific function; a subordinate set of building system components, as well as the principles or rules which logically link those components together to form a functional whole which is, in itself, an indispensible entity within a construction complex. Example: The HVAC subsystem would include the chillers, fans, pumps, ducts, and controls.

System: An interdependent set or assembly, consisting of the arrangement of building components or subsystems, as well as principles or rules which logically link those components together to form a functional building whole. Normally these components are mass-produced.

Systems Approach: A process stressing the interrelation of problem elements within an overall context.

Systems Building: The organization of programming, planning, designing, financing, manufacturing, constructing, and evaluating of buildings under highly coordinated management into an efficient total process; The use of proprietary building systems, usually highly standardized; indus-

trialized building, a process featuring a) user requirements, b) performance criteria, c) subsystem integration, and d) testing (or certification) of subsystems.

Systems Design: Application of the systems approach to a design process, characterized by close coordination of the development of all components, often by an interdisciplinary team of specialized designers; the utilization of information obtained by systems analysis in the design of systems; performance design.

Systems Integration: The combination of a group of relatively independent parts into a coordinated whole to improve performance through controlled interaction; the joint use of a component by two or more systems.

Technological Innovation: An advance attributable to a technical method or a new product which achieves a particular purpose. It can also be a significant change in the means employed to achieve a superior system or service.

Turnkey: A procurement method in which the owner specifies only the end product. The design and construction (and sometimes site acquisition) is the responsibility of the contractor, who must execute the work for the agreed sum within the agreed time limits.

Two-Step Procurement: A procurement option where—as Step I—technical proposals are received without dollar bids, and evaluated against predetermined criteria. Those firms whose proposals were deemed "responsive" are then asked to submit a bid—as Step II—to construct the facility according to their own proposal. The contract is awarded to the lowest bidder.

User Needs: Those conditions which the user of a building considers necessary or desirable as environment and support for his activities, without particular reference to how such conditions are to be physically produced.

User Requirement: Criteria based on occupant's (not necessarily owners') needs, translatable into performance or functional criteria.

SECTION TWO

ACRONYMS AND ABBREVIATIONS

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2:521 GOVERNMENT AND AND PROFESSIONAL ABBREVIATIONS AND ACRONYMS

ABS	Academic Building Systems (A public *systems* program in Indiana and California)
ADM	Administrative (herein grouped with CLR or classroom facilities)
A/E	Architect/Engineer
AF	Air Force
AMC	Army Materiel Command (source of some implementing instructions)
APP	Army Procurement Procedures
AR	Army Regulation (usually with a numerical suffix)
ASCE	American Society of Civil Engineers
ASPR	Armed Services Procurement Regulations
BEQ	Bachelor Enlisted Quarters (covered here under *housing*)
BOQ	Bachelor Officers' Quarters (covered here under *housing*)
BOSTCO	Boston Standard Component System
BRAB	Building Research Advisory Board (of the Building Research Institute)
BSIC	Building Systems Information Clearinghouse (an EFL affiliate, phased out in 1975)
CEC	Consulting Engineers Council
CEOP	Corps of Engineers Operating Plan
CERL	Construction Engineering Research Laboratory, Champaign, Illinois
CLR	Classroom Facilities (grouped herein with ADM or administrative)
CM	Construction Manager
CO	Contracting Officer
COE	Corps of Engineers (also CORPS)
COMP GEN	Comptroller General, whose decisions may affect future ASPRs
CONARC	Continental Army Command
CONUS	Continental United States (excludes Alaska and Hawaii)
CRRC	Construction Requirements Review Committee (OCE)
CRS	Caudill, Rowlett & Scott (A/Es) Houston
CWE	Current Working Estimate
DACA	Department of the Army Contract Authorization (with a numerical suffix)
DAEN	Department of Army, Engineers
DASD	Deputy Assistant Secretary of Defense
DCAS	Defense Contract Administration Service, with suffixes *D* for District, *O* for Office, and *R* for Region
DCSLOG	Deputy Chief of Staff for Logistics
DE	District Engineer
DMA	Defense Materials System (for regulation of critical materials)
DOA	Department of the Army (also DA)
DOD	Department of Defense (also DD)
DSA	Defense Supply Agency (source of some implementing instructions)
DSM	Defense Standardization Manual qualified products list; qualification procedures)
EC	Engineering Circular
ECI	Engineering Contract Instructions
E&D	Engineering and Design
EFL	Educational Facilities Laboratories (Subsidiary of Ford Foundation)
ER	Engineering Regulations (or COE Regs)
FCC	Federal Construction Council (under GSA)
FED SPECS	Federal Specifications
FHA	Federal Housing Administration (source of many standards—see SEB)
FPR	Federal Procurement Regulations (data processing and computer needs)
FSS	Federal Supply Schedules (GSA's stock catalogs)
FY	Fiscal Year
GSA	General Services Administration (Federal "housekeeper" and buyer)
GP	General Provisions
H&H	Heery & Heery (A/Es), Atlanta
HUD	Department of Housing and Urban Development
I&H	Installations and Housing
I&L	Installations and Logistics
IB	Industrialized Building(s)
IBS	Industrialized Building Systems; also International Building Systems (Dallas)
IBIS	Industrialized Buildings Information System
IF	Industrialization Forum (Publication)
IFB	Information/Instructions for Bidders
MBM	McKee-Berger-Mansueto, Inc., Chicago
MCA	Military Construction, Army
MIL SPECS	Military Specifications
NABM	National Association of Building Manufacturers
NAVFAC	Naval Facilities Engineering Command
NBS	National Bureau of Standards
NSPE	National Society of Professional Engineers
NTP	Notice to Proceed
OATS	Operations/Administrative/Training Facilities
OCE	Office of the Chief of Engineers
OMB	Office of Management and Budget (formally BOB, Bureau of the Budget)
OSD	Office of the Secretary of Defense
OTS	Office of Technical Standards (FHA's examiner of fabrication methods)
PBD	Program Budget Decisions
PBS	Public Building Service (GSA)
PL	Public Law (usually with a suffix number)
PM	Project Manager

RAS	Research in School Facilities (Montreal, Canada)
RFP	Request for Proposals (usually with one-step)
RFTP	Request for Technical Proposals (usually with two-step)
SCSD	School Construction Systems Development (California, 1963-68)
SEB	Structural Engineering Bulletins (FHA/OTS: they may provide traditional construction method equivalent for IBS)
SEF	Study of Educational Facilities (a Toronto, Canada, systems program)
S&I	Supervision and Inspection
SOA	Secretary of the Army
SSP	School Systems Program (Florida)
STO	Storage Facilities
SUNY	State University Construction Fund (New York)
TEC	The Engineers' Collaborative (Chicago)
TIBS	Technical Information on Building Systems (A CERL data bank on manufacturers, AEs, CMs and subsystems erectors)
TP	Technical Proposal
URBS	University Residential Building Systems, University of California)
USC	United States Code
VA	Veteran's Administration

2:522 TECHNICAL ABBREVIATIONS

a/c	air conditioning
btu	British thermal unit
cf	cubic feet
clg	ceiling
clr	classroom
cm	centimeter(s)
comb	combustible
cpm	critical path method (an activity-oriented NAS for job scheduling)
cp	critical path (the path of longest duration through a *cpm* network)
d&d	design and documentation
fc	foot candles
flr	floor
fob	free-on-board (transportation costs)
h	height (in measurement)
hvac	heating, ventilating and air conditioning
iic	impact insulation class
inr	impact noise reduction
k-factor	a measure of heat transfer through a construction unit
l	length (in measurement)
lf	linear feet
lob	line of balance (a job scheduling of factory fabrication)
max	maximum
mfr	manufacturer
min	minimum
nas	network analysis system (a job scheduling technique, possibly utilizing *cpm*, *lob*, or *pert*)
nc	noise criterion
pert	program evaluation review technique (an event-oriented *nas* for job-scheduling, primarily used in *r&d*)
plumbg	plumbing
psf	pounds per square foot
psi	pounds per square inch
rdte	research, development, testing and evaluation
revs	revolutions
r&d	research and development
sf	square feet
specs	specifications
stc	sound transmission coefficient
std	standard
sto	storage
tlq	temporary living quarters
u-factor	the measure of heat transfer through material width
w	width (in measurement)

SECTION THREE

FORMULAE DERIVATION

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2:531 COST FORMULAE DERIVATION

IBS cost formulae were developed through the use of regression analysis, which shows the relationship between a dependent variable (in this equation, construction cost) and one or more independent variables (in this equation, building area).

The sample of industrialized buildings from which the equation was developed came from three sources. CERL gathered observations during a survey conducted in 1971. These data were supplemented by more cost information added in 1972. In addition, cost data were also supplied by Building Systems Information Clearinghouse.

The Formulae

IB Construction Cost = $29,251 + 25.96 (Area)

R^2 = .68
SEE = 208,153
N = 50

Because the data used to develop the industrialized building cost equation came from buildings constructed for the private sector, a check was made to see whether the equation was applicable to the military sector. The IB equation was used to estimate the cost of several IB projects which have been constructed for the military. Below, the cost estimate is compared with the government estimate and the low bid for the same projects, along with percentage differences for each project.

Example 1

FY72 AF/IB Program (FWD): OATS Package
(All costs adjusted to a Feb., 1973 base)

Low bid	Package	Government Estimate	% Dif'c	CERL's Estimate	% Dif'c
$14,145,616	1	$8,246,788	**42%**	*$9,843,111*	**30%**
7,943,508	2	4,858,700	**39**	*5,789,968*	**27**
5,623,486	3	3,388,088,	**40**	*4,053,143*	**28**

Note: Figures for the subpackages in the comparisons need not necessarily add up to the total package

Example 2

FY72 AF/IB Program (FWD): Warehouse Package
(All costs adjusted to a May, 1973 base)

Example 3

FY72 AF/IB Program (FWD): Housing Package
(All costs adjusted to Feb., 1973)

Low Bid	Package	Government Estimate	% Dif'c	CERL's *Estimate*	% Dif'c
$27,288,439	1	$23,270,328	**15%**	*$22,070,243*	**19%**
5,158,800	2	4,881,371	**5**	*4,831,320*	**6**
13,997,000	3	11,162,332	**20**	*10,119,822*	**28**
8,132,639	4	7,226,625	**11**	*7,119,101*	**12**

this is example 2

Low Bid	Government Estimate	% Dif'c	CERL's Estimate	% Dif'c
$3,357,723	$3,586,789	**7%**	*$7,921,668*	**136%**

Example 4

Fort Knox, BOQ, Army
(All costs adjusted to March, 1973)

Low Bid	Government Estimate	% Dif'c	CERL's *Estimate*	% Dif'c
$3,300,000	$3,700,000	**12%**	*$3,242,664*	**2%**

These comparisons verify approximately the general applicability of the cost equation to the military sector. The regression equation was developed from buildings with average areas of 23,101 square feet. Since the Air Force industrialized warehouse is a mammoth structure of 324,000 square feet, it is clearly outside the range of applicability for the regression equation. Cost estimates for proposed projects can be obtained in a matter of minutes using the regression formula, as oposed to days of work if the estimates were based on quantity take-offs on materials and labor man-hours required.

2:532 CONSTRUCTION TIME EQUATIONS

An industrialized building sample was compiled with a conventional building sample to develop equations showing the number of months required to construct each kind of building, based on its area. Both building samples cost approximately $2.5 million.

The Formula

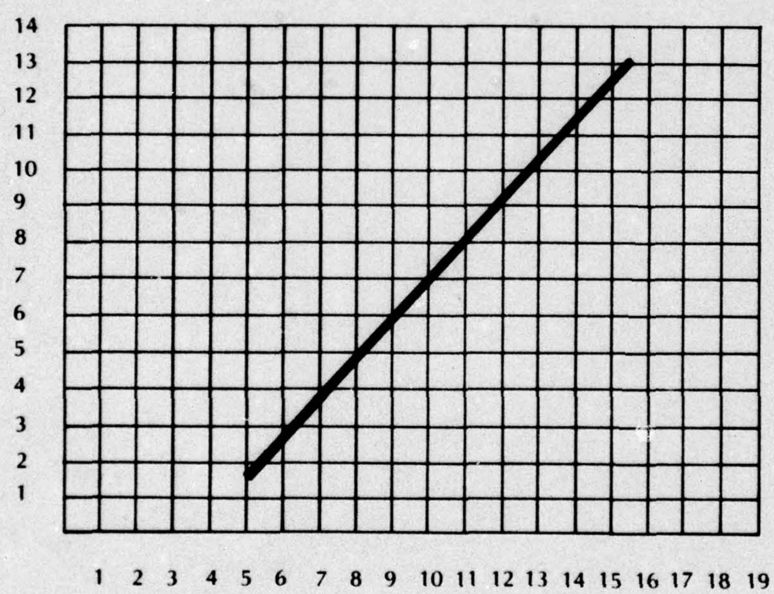
IB Construction Time (months) = 8.459 + (.000264) X (Area)

R^2 = .19
SEE = 3.57
N = 79

The **IB** and conventional equations were solved for area and combined into the following single equation.

IB construction time = -3.074 + (0.95) × (Conventional construction time)
Relationships Between Industrialized Building and Conventional Construction Time

Industrialized Building Construction Time (months)



Conventional Construction Time (months)

★ U.S. GOVERNMENT PRINTING OFFICE: 1976—653-537